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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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The Government's Industrial Policy

In his recent Manchester speech, the Prime Minister made an important reference to the relations between the State and industry. Those who have watched the enormous growth in recent years of State action in such industries as agriculture might be pardoned for feeling some apprehension with regard to the relations between Government and industry—apprehension which will be very largely allayed by this speech. The questions raised go right to the root of our efficiency as an industrial country and our existence as an Empire. The Prime Minister emphasised that the price of freedom in the exercise of business initiative is the recognition of certain responsibilities. While we have modified the business basis of the Victorian era, we are still individualists. The Government desires to make its intervention in industrial affairs an irreducible minimum, but we can no longer tolerate inefficiency. A business enterprise affects the fortunes of many beyond those of the proprietor or manager, and a country which has granted the inestimable boon of protection cannot afford to see that privilege treated lightly. We have to compete with nations who have surrendered their liberty, willingly or otherwise, and whose actions can therefore be determined by single individuals or small groups. This power gives them a saving in time and a directness of aim which the democratic countries must keep in mind.

The changes brought about since the war have been enormous, but the Government's interference has been restricted in the main to making the conditions for industry as easy as possible, a state of affairs which is only proper, since it is to industry that the Government must very largely look, directly or indirectly, for the yield of taxation. The Prime Minister's words cannot be improved. He said: "Broadly speaking, I would say that the proper function of government in relation to industry is to create the conditions in which trade and commerce can be most successfully carried on, only exercising as much control as may be necessary in the public interest." Referring appreciatively to the work of the Department of Scientific and Industrial Research as another aspect of the co-operation between science and industry, he doubted still whether industry is spending enough upon the important matter of research.

The old trades which used to be the staple industries of this country have one by one become the common practice of the world. Our task is to find new lines of manufacture, but these can only be successfully established by intensive research and full utilisation of results.

Apprentice Moulder Training

Every year at this period, amateurs, like ourselves, are expressing their views on the training of trade apprentices. We only too often receive letters from aspirants to managerial positions which produce ample evidence of practical experience, and ask us, if the writers took a course at this or that centre, whether they could then reasonably expect promotion. We seldom have the courage to tell them that their prime requisite is a modicum of normal business essentials. By this we mean an ability to think clearly and to express their thoughts in good readable English. Our experience is that the average foundry apprentice does not need additional tuition in foundry practice, but rather a continuation course in the three R's. During the period of his apprenticeship his evenings would be better spent as a Scout, Rover or Territorial than worrying about the calculation of mixes for cupola melting. If these organisations are properly conducted, they should teach a lad the elements of leadership and mental alertness. These two factors should enable him to learn whatever is available at his place of work and not to be afraid of assuming leadership when the time arises. Too much technical education induces a type of mental indigestion, and the patient is so dull as to make him a pariah in general society. These remarks do not, and must not, be intended to apply to those possessing a natural aptitude for the acquisition of technical knowledge, a *sine qua non* for which is the initial possession of a good general education. The proper place to train apprentices is in the foundry. The provision of external facilities is all that can be expected from the educational authorities, and any success these efforts may secure is due to the personality of the lecturers and never to incentives made by the employers. There seems to be a ridiculous and unreasonable animosity to draughtsmen and patternmakers participating in foundry courses, and the suggestion immediately arises as to why neophyte moulders do not reverse engines and look into allied trades. Most successful foundry executives possess interests other than foundry technology, and it may be that better progress is registered by deflecting one's activities for a certain period each week to some outside interests.

Institute of British Foundrymen

ELECTION OF NEW MEMBERS

At a Council meeting of the Institute of British Foundrymen, held in Manchester last Saturday, the following were elected to the various grades of membership:—

As Subscribing Firms

Dunswart Iron & Steel Works, Limited, Anglovaal House, 71, Fox Street, Johannesburg; Stein & Atkinson, Limited, 47, Victoria Street, London, S.W.1.

As Members

R. O'C. D. Boyd, Mather & Platt, Limited, Manchester; L. B. Bull, works manager, Coneygre Foundry, Limited, Tipton; E. McL. Cleland, coke and pig-iron salesman, W. Baird & Company, Glasgow; C. R. Day, metallurgist, H. V. McKay-Massey Harris Pty., Limited, Victoria, Australia; D. D. Douglas, engineer, Box 76, Krugersthorp, Transvaal; C. Drabble, planning engineer, Rootes Securities, Limited, Bristol; C. J. du Plessis, works superintendent, City Engineering Works, Pretoria, South Africa; G. H. Froggatt, director, J. C. Barnsley & Company, Sheffield; T. E. Gray, analytical chemist, T. E. Gray & Company, Limited, London, W.C.1; W. J. Grose, foreman patternmaker, Wright, Boag & Company, Limited, Johannesburg; J. K. Howard Hall, managing director, Fleetlands Boat Yard, Fareham, Hants; R. H. Hancock, production manager, J. A. Crabtree & Company, Walsall; W. Holland Harper, director, J. Harper & Company, Willenhall; R. Henderson, foundry manager, Short Bros., Rochester; W. Hobson, works manager, P. Pierde Company, Wexford; A. R. Hudghton, foundryman, Debdale Park, Manchester; G. L. Hunt, foreman patternmaker, Union Steel Corporation of South Africa, Limited; H. G. Issels, engineer, F. Issels & Son, Bulawayo; B. S. Morgan, superintendent of foundries, B.T.H., Rugby; B. Needleman, B.Sc., metallurgical chemist, Union Steel Corporation of South Africa, Limited; Miss J. F. Rogers, secretary, DeLacy-Evans, Limited, London, S.W.1; H. Scott, foundry director, H. Edie & Company, London, E.6; J. Smellie, foundry manager, A. G. Wild & Company, Sheffield; G. S. Thonger, chemist, Austin Motor Company, Birmingham; Dr. Eng. H. J. van Eck, M.Sc., joint managing director, Dunswart Iron and Steel Works, Johannesburg; C. G. While, company director, G. & R. Thomas, Limited, Bloxwich; L. Whitehouse, J.P., pig-iron salesman, G. & R. Thomas, Limited, Bloxwich; G. F. Whitmarsh, master non-ferrous castings manufacturer, Birmingham; R. S. Wild, director, A. G. Wild & Company, Sheffield; F. C. Williams (Secretary of South African Branch), secretary of companies, 75, Fox Street, Johannesburg; W. J. Wilson, foundry equipment salesman, Stafford.

As Associate Members

J. M. Anderson, moulder, Carntyne Steel Casting Company, Limited, Paisley; V. N. Bharadwaj, apprentice, N.W. Rly. Loco. Shops, Moghalpura, India; H. L. Blamires, apprentice metallurgist, Modern Foundries, Limited Halifax; C. Board, moulder, City Engineering Works, Pretoria; M. Board, moulder, City Engineering Works, Pretoria; S. F. Botes, patternmaker, City Engineering Works, Pretoria; E. H. Brown, engineer, London, S.E.; R. H. Brown, foundry foreman, Hayward Tyler & Company, Luton; C. H. Cheshire, metal patternmaker, Meynell & Sons, Limited, Wolverhampton; I. Clayton, foreman moulder, J. Pickles & Son, Hebden Bridge; E. Crabtree, moulder, Ley's Malleable Castings Company, Derby; H. E. Crivan, metallurgical chemist, English Steel Corporation, Sheffield; G. A. Dyson, foreman patternmaker, Darwins, Limited, Sheffield; R. Foster, foundry progress clerk, Blakey's Boot Protectors, Limited, Leeds; G. E. Harrison, moulder, Horsley Bridge & Thomas Piggotts Company, Limited, Tipton; G. M. Holmes, foundry laboratory assistant, Ley's Malleable Castings Company, Derby; J. W. Howarth, apprentice patternmaker, Blakey's Boot Protectors, Limited, Leeds; G. P. Hoyle, foundry metallurgist, English Steel Corporation, Sheffield; A. McKerracher, moulder, Morrison & Ingram Company, Manchester; C. Meredith, foreman moulder, Tangyes, Limited, Smethwick; T. D. Miller, patternmaker, J. Stone & Company, London, S.E.; E. J. Nation, moulder, Gillett & Johnston, Limited, London, S.E.; G. F. Oliver, assistant chemist, North Lonsdale Iron & Steel Company, Ulverston; F. C. Porter, foundryman, Mason & Porter, New Zealand; G. W. Reid, moulder, Lightalloys, Limited, North Acton; A. Robjant, patternmaker instructor, City and Guilds Engineering College, London; E. W. Rowley, castings inspector, Ley's Malleable Castings Company, Limited, Derby; M. S. Sen, moulder, Noamundi Iron Mine, Tata Iron & Steel Company, India; L. E. Slater, patternmaker, Lake & Elliot, Limited, Braintree; A. Stewart, foreman moulder, Carntyne Steel Casting Company, Renfrew; W. Syme, metallurgist, H. Balfour & Company, Leven; A. Talbot, moulder, Vickers, Limited, Crayford; H. Taylor, assistant manager, Laurence, Scott & Electromotors, Norwich; M. A. Wardle, junior assistant to foundry manager, Qualcast, Limited, Derby; L. J. Waters, metallurgical chemist, Holman Bros., Cornwall; A. Watkinson, assistant metallurgist, Crofts, Limited, Bradford; W. Woolstencroft, foreman moulder, Joseph Berry, Limited, Swinton; C. Wormald, patternmaker, City Engineering Works, Pretoria.

Associates

A. Cluley, patternmaker, Qualcast, Limited, Derby; A. S. Lishman, apprentice moulder, Eclipse Tube Mill Liners, Limited, Benoni, South Africa; H. B. Sayer, moulder, Eclipse Tube Mill Liners, Limited; R. Smith, moulder, Eclipse Tube Mill Liners, Limited.

Students (Associates)

J. C. Chatterton, metallurgical chemist, British Foundry School, Birmingham; J. R. D. Kirby, apprentice moulder, Coltness Iron Company, Glasgow; T. J. Primrose, special apprentice, Rover Company, Limited, Tyseley, Birmingham.

Iron and Steel Production

The British Iron and Steel Federation reports that there were 132 furnaces in blast in the United Kingdom at the end of September, compared with 131 furnaces at the end of August, two furnaces having been blown in during the month and one having ceased operations for relining. The production of pig-iron in September amounted to 726,600 tons, compared with 714,000 tons in August and 650,800 tons in September, 1936; the month's production included 162,700 tons of hematite, 391,100 tons of basic, 144,900 tons of foundry and 10,200 tons of forge pig-iron. The production of steel ingots and castings in September amounted to 1,163,000 tons, compared with 987,700 tons in August and 1,027,000 tons in September, 1936. Consequent upon a further increase in pig-iron output, the production of steel ingots was the new record for this country, and brought the nine-months' output figure up to 9,548,300 tons (against 8,617,200 tons for the first nine months of 1936), the highest output for three quarters ever achieved by the steel industry. Pig-iron output reached the highest daily rate since September, 1920.

Random Shots

There is no knowing what talent lies beneath the moulders' sand-blackened exterior—and anyone who is in London with a short time to spare should spend it by going to see an exhibition of pictures at 56, Brook Street. It is a very interesting collection of oil paintings of scenes, mostly from Ireland and Majorca, by Mr. Frank Nortcliffe, who is by turns an artist and a moulder. Next time Mr. Nortcliffe feels he must run away to the countryside to give expression to his art, could no one persuade him to stay for a while in his foundry with canvas and brush? Just long enough to paint that magnificent subject right at his very doorstep, the flow of metal from the cupola, with its light reflecting on the moulders standing ready with their ladles?

* * *

Whatever else Mr. Nortcliffe has done, he has learnt a tremendous secret of a happy existence in this hard, cruel world. Too many men spend all their energies achieving success, only to find when they have arrived, that they have forgotten how to enjoy it, having left the cultivation of art, literature and music behind in the struggle. Bravo, Mr. Nortcliffe!

* * *

Now that metal scrap is fetching good prices, thieves are getting busy. Four men were recently accused in a London Court of stealing £1,500 worth of brass. One wonders during what other period of England's history the price of brass scrap sky-rocketed, for surely Cromwell cannot be blamed for all the thefts of brass memorial plate, of which there is evidence in an alarming number of old churches about the country.

* * *

Extract from Russian Foundry Journal.

One of the conditions stipulated by the Moscow Underground Railway Authorities in regard to the supply of cast-iron tunnel segments was that each machined edge of a segment should not contain more than five cavities. It was not possible to comply with this stipulation in all cases, and permission was given to supply segments in which the number of cavities was greater than five, on condition that the holes were filled in with a suitable cement, which had to satisfy certain requirements. An asphalt mastic cement was found to be the most suitable for the purpose and satisfactorily withstood the tests carried out on it for ascertaining its resistance to corrosion and its resistance to impact.

Junior would no doubt take great pleasure in filling the offending cavities with the school suet pudding!

* * *

With the Motor Show at Earl's Court and the Ford Show at the Albert Hall, everyone is thinking of cars and the road just now. It is pleasing to see that many roadside petrol stations are making a very commendable effort to cater for the needs, not only of the car, but of its occupants, by providing cafés, cloakrooms, etc. One hopes that motorists will ensure their success by taking full advantage of their amenities, but how can they do this without running into them?

* * *

That is one traffic problem. Here is another. How many traffic rules were broken by the lorry driver who went the wrong way up a one-way street, crossed over a Belisha crossing without stopping for pedestrians, and went straight on in spite of the red light? Answer next week!

* * *

Young lady, to policeman at a busy cross-road: "What's the idea—no traffic light here?"

Policeman: "I'm the light at this corner, lady."

Young lady: "Then turn green, so that I can cross."

"MARKSMAN."

Moulding Chemical Kettles

By PAUL R. RAMP

We recently printed a method of making a nitric acid kettle as practised in South Africa. This article reprinted by courtesy of the "Iron Age" discloses an American system.

Large kettle castings are moulded many different ways. This to a greater extent than is realised is the cause of failure or success in their production. Seldom is enough thought given to the reactions that take place when the mould is filled and the metal is still in the molten state, and sometimes after it has solidified.

If the casting comes out of the mould with a smooth surface, true to pattern, and is of the desired analysis, most foundrymen are satisfied that they have done a good job. It has been demonstrated, however, that a more careful study of mould conditions, mould materials, and moulding methods improves the quality and prolongs the life of the kettle very materially.

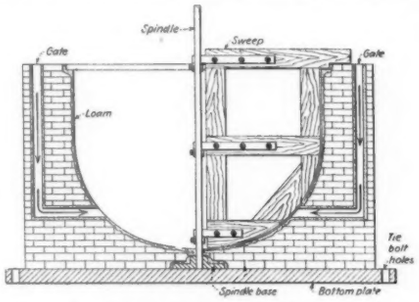

Fig. 1.—Cross Section of Drag Mould showing Sweep and Spindle.

A dry-sand mould is used by some, using a sweep to shape the mould. The result is an irregularly rammed surface that produces numerous different thicknesses of metal throughout the entire casting. Though small, these variations are numerous and set up minor internal strains which shorten the life of a casting subjected to hard service.

The ramming of these dry-sand moulds in conjunction with the sweep method cannot be uniform, and many places that are rammed too hard create spots in the mould that cause undesirable agitation even to the extent of producing a scab or a cut on the surface of the mould. Such practice also produces a metal with sand particles mixed in it which are readily attacked by the chemicals and heat. These sand particles may not be discovered on the surface, but they are there and eventually show up in service with some very expensive results. These are but two of the important reasons why a dry-sand "swept-up" kettle mould is not the correct mould to produce a high grade casting.

Making kettle moulds by using cast iron prickered brick with perforations in the brick for vents, and covering the brick with a coat of loam would appear to be a good method, especially from an economic point of view, if it were not for the rapid cooling of the metal caused by the absorption of the heat by the metal brick. This has a semi-chilling effect on the casting, causing the development of small checks or cracks which eventually break down the metal structure and shorten the life of the kettle. The method of using the same mould surface several times, by carefully lifting the casting out of the mould is cheap but very unreliable, and always results in dirty metal even though the surface of the casting may appear good.

The gating of these kettle moulds is many times in error. Gating from the top with pencil gates is almost standard practice and would be correct if the first iron that entered the mould—the "wash iron"—was not deposited on the bottom of the casting and allowed to remain there where the best metal is required.

The idea of moulding the kettle bottom up because the bottom is twice as heavy as the side—with the thought that it is easier to feed the heavy bottom, is a mistake, as it will not produce a good casting.

Method of Gating and Pouring Important

The method of gating and pouring highly alloyed kettle or pot castings has a great influence on their life in service. When molten metal comes in contact with the surface of a mould an agitation is created that affects the quality of the metal. This agitation may be hardly noticeable but it can have a damaging effect on the quality of highly alloyed iron. It is advisable, therefore, to direct the flow of the metal in a manner that will eliminate this agitation before solidification takes place. The first metal that covers a vital portion of a mould must not be allowed to remain at that point, but after it has served its purpose as a preheater and cleanser, it must be pushed along to a less important part in the mould. This is more important in the production of alloy castings than in castings without alloys because metals containing a high percentage of alloys are more sensitive to mould conditions than ordinary iron.

The material used to make these moulds reflects itself in the life of the casting. A material that produces a smooth casting does not always produce a sound casting, or a casting that will stand up in service when subjected to the action of chemicals or heat, even though it may contain the specified percentage of alloys. It has been found that in the production of high grade chemical castings some of the moulding methods and moulding materials used years ago are of decided value to-day.

With this in mind, the method of moulding a kettle casting to produce a high grade alloy casting that will stand up in service will be described.

Fig. 1 is a cross section of the drag part of a 12-ton kettle mould, with the sweep in position, the brick work completed, and the loam applied to the brick swept to the desired shape to form the outside of the casting. The gates leading from the joint to the bottom of the mould shown are formed by the use of dry-sand cores made in lengths that enable the moulder to build up the gate at the same time the bricks are being laid. This completes the work of making the drag mould.

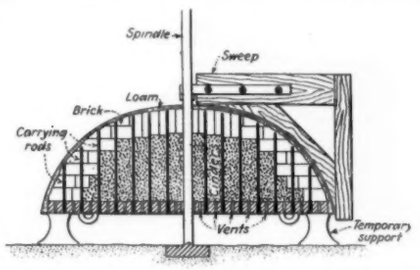

Fig. 2.—Cross Section of Completed Crown Plate with Sweep in Position.

The next operation is to reduce the size of the sweep so it will form the inside dimension of the kettle. This is accomplished by removing a thickness strip or false edge that has been attached to the sweep, to form the greater outside diameter of the mould. The method used to secure the desired thickness of the kettle is as follows:—

Twenty strips made of wood that conform to the shape of the outside of the kettle on one side, and to the inside on the other edge, are placed in the drag mould equally spaced. The spaces between these thickness strips are filled with black sand, properly tempered black sand, the sweep is again used to sweep the surface of the black sand to the required size and shape. This done, the sweep and spindle are removed and the mould is ready for the crown plate. The crown plate is in reality the lifting plate that carries the part of the mould which forms the inside of the kettle.

Fig. 2 is a cross section of a crown plate just completed and ready for drying. This plate consists of a heavy plate with long prickers or carrying-rods cast in it. The carrying-rods

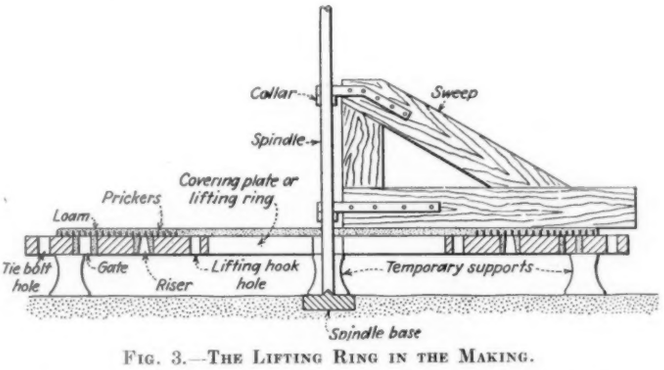

Fig. 3.—The Lifting Ring in the Making.

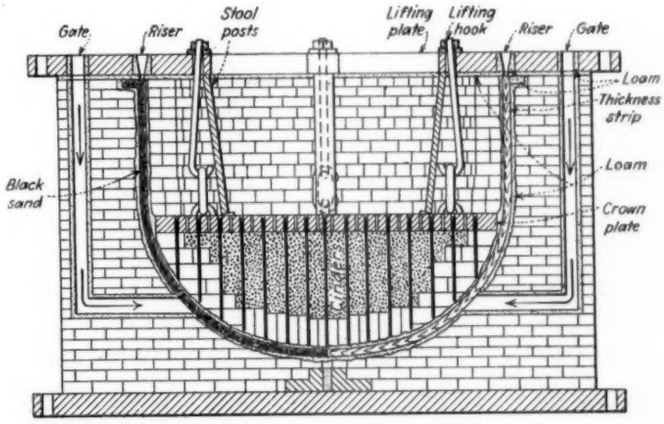

Fig. 4 (Right).—Cross section of Kettle Mould Ready for Lifting off the Cope.

shown in Fig. 2 are used to carry the brick employed in making this part of the mould. Numerous holes marked "vents" are also cast in the plate in order to provide an escape for the gas generated when the mould is cast.

The bricks are held in place by means of small metal wedges driven between the bricks and the carrying-rods. When these bricks have been properly secured a coat of loam is applied and the sweep is used to shape the inside bottom of the kettle. While building the brick, the space between the brick and the heavy metal plate is filled with cinders, which provide for prompt escape for the gas. After the mould has been formed on the crown plate as described, the sweep and spindle are removed, the mould given a coat of blacking and placed in a stove to dry.

After the crown plate is dry enough to handle without the loam falling off it is removed from the stove, turned over and placed in the bottom of the drag mould, allowing it to rest upon the thickness strips and the black sand. If it fits properly the next procedure is to build up the balance of the inside mould of the kettle with brick and loam until the level of the joint of the mould is reached. This is done in the usual manner of loam moulding with a pattern. The black sand and the thickness strips represent the pattern.

The next operation is to provide a lifting ring or cope, which is used to carry the inside part of the mould. Fig. 3 is a cross section of the lifting ring in the making. Prickers are provided to carry the loam on the surface that will come in contact with the drag mould and form the top of the flange. In this case the loam is used very dry and rammed on the plate and struck off level with the sweep. The sweep is shown in Fig. 3. The lifting ring mould is finished and dried, then turned over and placed upon the moulds and properly secured to the centre core by heavy hooks that fit into loops cast in the crown plates for that purpose.

Fig. 4, a cross section of the kettle mould ready for the cope to be lifted off, shows the result of all the work previously described. The mould is built upon a heavy bottom plate that is used as a binder in conjunction with the lifting ring when the mould is being poured.

The position of the crown plate part of the mould is shown with the continuation of the brick wall that has been built above it. One half of the cross section shows the thickness strips and the other half the black-sand thickness.

The lifting hooks that extend through the lifting ring and connect with the loops in the crown plate carry the entire weight of the inside core of the mould. The stool posts are used to help resist the lifting pressure that is exerted against the core when the mould is full of molten metal.

The next procedure is to lift out the centre part of the mould. This is done by attaching heavy slings to the lifting lugs on the lifting ring. After the cope has been lifted off the black sand and thickness strips are removed and the surfaces of both drag moulds are finished, blacked, and thoroughly dried.

Fig. 5 is a cross section of a 12-ton chemical kettle mould ready for pouring. This mould is poured with two ladles in order to secure a better distribution of the metal and better to direct the flow of same. Note the two pouring basins and the gates leading from these basins to the bottom of the mould. This plan of gating forces the first metal to rise to the top of the mould after it has flowed over the bottom surface, which heats up the bottom and permits the final metal to lie quietly without any agitation at this point. The tie-bolts are shown that extend through the lifting ring and the bottom plate and bind the mould together.

The mould is made in a pit to make pouring easy and is held together by ramming sand firmly between the outside of the brick walls and the usual steel curbing. Additional weights are used as shown; they extend over the mould far enough to permit them being supported on the foundry floor. To prevent their weight from crushing the mould, after the weights have been placed with a 2-in. space between their lower surface and the top of the lifting ring, metal wedges are driven between the weights and the lifting ring. This is sufficient weight to hold the cope down without any danger of crushing the mould. The risers or flow-offs are shown extending through the lifting ring.

The mould made of loam in this manner assures a mould with a uniform hardness of surface, that produces a casting of uniform thickness and a mould surface which will not cause any agitation of the metal.

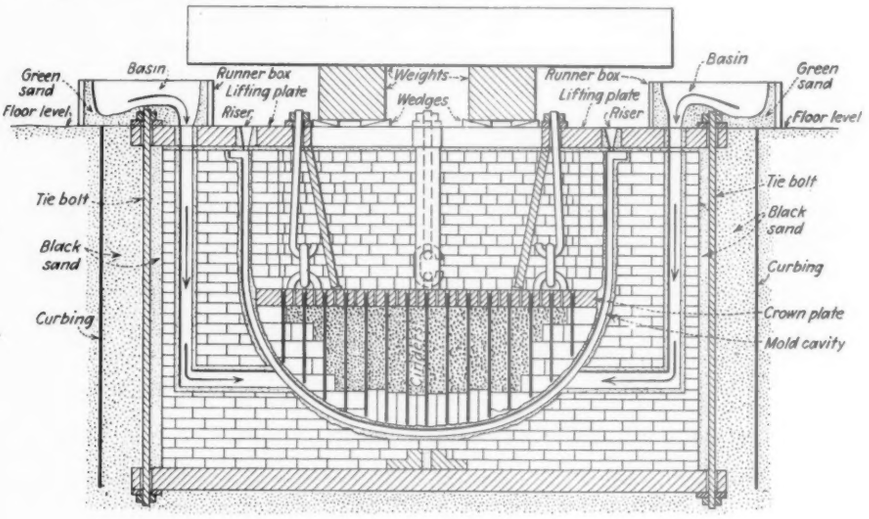

Fig. 5.—Twelve-Ton Chemical Kettle Ready for Pouring.

Casting of Railway Vehicle Wheels

According to A. N. Petrov, in an article in "Liteinoe Delo," one of the chief difficulties encountered in the casting of steel wheels for railway vehicles is the formation of shrinkage cavities in the wheel rims. The possible causes of these defects are discussed and an account is given of actual practical attempts to produce sound castings. It was found that the formation of such cavities could be eliminated almost entirely by casting with the mould arranged at an angle of 15 deg. to the horizontal. The drawback of this method is the increased amount of molten metal required for casting each wheel.

Ship's Bell in Alloy Steel

The accompanying illustration represents a ship's bell made by Hadfields, Limited, for the new war vessel, H.M.S. "Sheffield," and presented by Sir Robert Hadfield, Bt., F.R.S. The bell is made throughout of Hadfields "Era C.R." non-corroding steel, a special alloy steel that offers a high resistance to corrosion, and in this respect is unique in being probably the first bell of its kind to be made of a steel possessing this special characteristic.

The casting itself is a splendid example of the founder's art in a very intractable material, and no blemish was found in any part of it during the subsequent operations of machining and polishing. The clapper was made in two parts, the ornamental bulbous end being cast, whilst the shank with its suspension hook was made from a forging. These were assembled by screwing the threaded end of the shank into a tapped hole in the bulbous head and then welded at the joint to prevent their coming loose. The gallery was attached by screwing it on to a threaded projection, forming an integral part of the bell at the top and afterwards further secured at the four corners by countersunk headed screws fitted underneath inside the bell. The City of Sheffield coat-of-arms, cast in relief, is mounted on each side of the gallery. The bell is 22 in. dia., weighs approximately 2½ cwts., and gives a clear ringing note C sharp of the musical scale. In addition to the moulding and casting, the work of machining, fitting and polishing, also the engraving of the letters on the outside of the bell, was executed by the firm's own workmen.

Ship's Bell presented by Sir Robert Hadfield, Bt., F.R.S., to H.M.S. "Sheffield."

Molybdenum in Cast Iron

In a recent number of the "Analyst," E. Taylor-Austin compares the lead-molybdate, the sulphide and the alpha-benzoinmonoxime methods for the estimation of molybdenum in cast iron. All methods give satisfactory and reliable results, but the last is applicable to samples of less than 3 gr., while it is also more rapid and separation of the molybdenum from other constituents is effected in one operation.

Coreshop Cost Reduction

DISCUSSION AT MANCHESTER

The autumn session of the Lancashire Branch of the Institute of British Foundrymen opened on October 2, at the Engineers' Club, Manchester, Mr. R. A. Jones (Branch-President) being in the chair. MR. N. P. NEWMAN, of Woodchester (Glos), read a Paper entitled "How to Reduce Coremaking Costs." The Paper has already been published in the JOURNAL.*

Vote of Thanks

MR. H. V. GRUNDY, in proposing a vote of thanks to Mr. Newman for his Paper, said that it provided not merely food for discussion during the meeting, but also rich material for serious study in more leisured moments. It would be difficult for anyone to deal with such a subject in greater detail.

MR. A. PHILLIPS seconded the vote of thanks. He suggested it would have been easier for the members to have joined in a discussion upon the Paper if the author had utilised lantern slide illustrations of the machines described.

The vote of thanks was carried unanimously.

MR. NEWMAN, responding, said that it gave him great pleasure to meet so many members of the Lancashire Branch. He came among them mainly in order to learn something himself. He regretted that he had not been able to show any slides or drawings, but until the previous afternoon he was not aware that a lanternist would be available, otherwise he would have made a real effort to have brought some. Nevertheless, he had brought a few samples of the type of cores produced in the works with which he was associated. Perhaps the ideas put forward in the Paper might appear to be ideal, but he could definitely state that up to a certain point they did operate. Difficulties were always being encountered in a coreshop, and his own was no exception to the rule. There was at least one gentleman present—Mr. Wallwork—who had visited the foundry, who could state that the results described in the Paper were actually being achieved to a very great extent.

Notched-Bar Impact Testing

MR. J. E. COOKE (Hon. Secretary of the Branch) drew attention to the fact that under the auspices of the Joint Committee on Materials and Their Testing of Technical Institutions and Societies in Great Britain (24 in all), the Manchester Association of Engineers, as a constituent member of the Committee, had arranged for a technical discussion to take place in the College of Technology, Sackville Street, Manchester, on October 29 at 2.30 p.m.

DISCUSSION

MR. J. E. COOKE, opening the discussion, wished for a little more information concerning the blowing of cores. Mr. Newman had mentioned that one disadvantage was the cutting action of the sand upon the receptacle into which it was forced. A second disadvantage was the formation of air pockets, which at times created considerable difficulty. Would Mr. Newman enlarge upon the methods of overcoming both disadvantages?

Effect of Blowing on Boxes

MR. NEWMAN said that the first point could be divided into two. One part of it was the cutting action in the coreboxes. He thought the firm with which he was associated acquired the first core-blowing machine in the country, in 1924, and they had it for about two years before they knew what to do with it. It was quickly found that the type of equipment used for hand coremaking was, generally speaking, unsuitable for machine blowing. Recently they turned over to cast iron, which was even reinforced with steel when necessary, in order to minimise as far as possible the wear of a corebox by sand abrasion. It would be noticed that the specimen quadruple corebox available for inspection was made of cast iron. It was an expensive box, but it had a very long life in service.

With respect to air pockets in the core, in order to blow sand, it was necessary to blow air with it. The whole problem revolved round the point of how to eliminate the air and leave the sand in the right place. Practically every job had to be studied individually, and experiments conducted until it was ascertained correctly how the air could be relieved. There were very few definite rules, but there was one which certainly worked out very well. Never relieve the air from the end of a corebox; in other words, never relieve the air from the place the sand first reached. Take the sand there with the air, bring the air back through the side, or even through the top of the corebox, otherwise an air pocket would be formed. The venting was mainly done through the side, and that was how the difficulties with pockets were largely overcome. There was no definite rule; core blowing was really a study in itself.

Use for Small Cores

MR. J. A. REYNOLDS inquired whether the method described could be applied to very small cores, of which his firm manufactured thousands, varying in diameter from $\frac{5}{16}$ to $\frac{3}{4}$ in., with a slight taper, and from $\frac{1}{2}$ to $1\frac{1}{2}$ in. in length. At present they were made mainly on an iron plate, and, having taper, they were pushed out.

Range of Output

MR. NEWMAN said he could only repeat what he had already said, namely, that there was practically no limitation for blowing. Some jobs were so simple and they could be produced so speedily by other processes and methods that it did not pay to set up an equipment for core blowing. He thought, however, that those jobs were very few in number. There was no limitation in regard to size. His firm made all types of valves and fittings, ranging from $\frac{1}{4}$ in., which was very small, up to 12 in. Any of those sizes could be blown. The problem for each individual foundry could be worked out without any great difficulty. Having ascertained the actual cost of producing a certain type of core by existing methods, it was possible to obtain very quickly an idea of the economic production obtainable by a core-blowing machine. Most of the makers of such machines would be able to give reliable advice if furnished with the approximate cost of other methods. They did not, however, usually tell the purchaser how to do it; he generally had to find out for himself. Personally, if he was shown a core, he would be pleased to offer any advice and render any assistance of which he was capable with regard to suggestions in core blowing. Obviously, another limitation to core blowing was when there were a number of small loose pieces which had to be removed every time a core was made. Under such circumstances the machine was perhaps being used for 10 minutes, out of which up to 9 minutes was spent in removing the core from the box; it obviously did not pay to blow cores under such circumstances.

Underlying Principles

MR. H. V. GRUNDY asked what decided Mr. Newman in regard to the suitability of a core for a blowing machine. He understood that the adoption of any machine depended largely on the amount of hand work which could be eliminated, and the length of operation time for the machine. In view of all the difficulties the speaker had referred to, it was evident that if small cores were made, as was apparent from the samples shown, huge quantities were necessary. Considering the expensive coreboxes which had to be provided and the amount of experimental work involved in overcoming the difficulties referred to, it appeared to him there were great limitations in regard to the general run of suitable jobs in most foundries. He thought it must be highly-specialised work for which a core-blowing machine was a suitable proposition.

MR. NEWMAN said that was a correct statement. It was exactly the same with any machining side of a business. One type of job could be machined by automatic machinery because of the great quantity; another type did not pay to machine automatically because of the small quantities required. There were two types of jobs which could be put on to a core-blowing machine. One type was a mass-production job where the same job was being blown day in and day out, or there was the type of small job of which perhaps only 250 articles were required at one time, but this number was repeated frequently through the year.

Upkeep

MR. ARTHUR SUTCLIFFE asked what was the normal expenditure in order to keep the machines in repair? He would like some information with respect to loam cores, bowl and pipe cores.

MR. NEWMAN said that the cost of keeping a core blower in proper order was presumably proportionate to the cost of any other kind of mechanism. The most expensive cost of a core blower was the means of power, which was compressed air. A great deal of money could be lost by careless operators who wasted compressed air and did not put it into production. He did not profess to be a loam core specialist, and therefore could not offer any advice upon the particular problems connected with that subject. What he desired members to understand was that repetition had its problems also. Merely because one could make 100 or 1,000 cores right, that did not mean that one would be able to go on making them right indefinitely.

No Vent Needed

Answering another questioner, Mr. Newman stated that venting could be discarded on 6-in. cores if they were blown. Irons were not put in machine-blown cores; they must be carried during drying. He was now producing cores from a blower without carriers, and in many instances the green bond strength was reinforced by means of jig wiring. The wire was placed in the box, and held by the jig during blowing, and the core removed from the wire in position. Due to the system of blowing, all the grains of sand were separated by air. Tobacco smoke could be blown through any of the blown cores. They were absolutely open, and there was not any necessity for vents. He had also seen exhaust manifolds produced without any irons at all, but carried.

Sand Mixtures

MR. W. HOWARTH asked for further information as to the type of sand used in a core-blowing machine.

MR. NEWMAN replied that it was most important to use a correct mixture of core sand. Personally, he must have experimented with at least 40 or 50 different types of core-sand mixtures, only three of which had given really satisfactory results. He had standardised one particular mixture of bonded sand: 42 parts of silica sand, dried; 3 parts of red sand (Mansfield or equal sand) which was damp; 2 parts "Glyso" cream, 444, or equivalent, and $\frac{1}{2}$ part of linseed oil. It would be found that such a sand could be left in the machine for half a day if, for some reason, production had ceased. Blowing could be resumed with the same sand. There was no balling action, or little lumps of sand getting together, and causing lumps and

D2

* FOUNDRY TRADE JOURNAL, March 26, 1936, pp. 241-3.

rough places in cores and consequently in the castings. By working strictly to mixture satisfactory results could be obtained.

Mr. Howarth suggested it was the slight mixture of linseed oil which created the quality. Without linseed oil it was practically impossible to put one class of sand in the machine, and blow small cores continuously.

Mr. Newman agreed, and in reply to an inquiry as to the pressure at which the cores were blown, said about 80 to 85 lbs. per sq. in., both for soft and bonded sand.

Mr. J. A. Reynolds understood that difficulty was experienced with regard to sticking of sand in some of the earlier machines, and that a type of paddle was used to keep the sand moving.

Mr. Newman replied that the statement was quite correct. The very first machine was known as the "Demmler" machine, of which his firm had two. It was undoubtedly the simplest machine to work. A very soft bonded silica sand was used in combination with linseed oil, and there was no sticking. There was, however, the disadvantage that all the cores had to be carefully handled and carried until they were baked. A modern type of machine was one which stirred mechanically the sand in the hopper instantaneously with the blowing, and then stopped until the next sequence of operations.

Core Dressing

Mr. R. S. Yeoman (Stoke-on-Trent) asked whether Mr. Newman applied dressings to any of the cores he made, and, if so, did he allow the core makers to dress the cores, or had he found that it helped the flow of production to have separate dressers?

Mr. Newman said he never allowed a core maker to touch the cores after they were dried. They ought then to be quite independently inspected, and dressed by a separate gang of workers or inspectors, so that there was no collusion whatever with the core makers.

Answering a question by Mr. A. Hopwood, Mr. Newman thought that unless a firm was going to save in cost there was not very much encouragement for it or anyone else to endeavour to progress. It was only by progression that one could build up a business and compete with rival undertakings. His view was that if, by the introduction of new equipment, a saving could be effected in production time, then it would be a great mistake so to cut down piecework prices that the worker virtually went home with the same amount of remuneration. If the worker could be convinced that by the installation of new equipment greater production would result, and he could earn more remuneration, while at the same time production costs were lessened, then very little trouble was likely to arise from the change. The worker would naturally expect to earn more; that was progression. There must be give and take on both sides.

An Invitation

Replying to other speakers, Mr. Newman stated that all the core examples exhibited were of standard production. They were not strong bonded; they were all blown cores. A blown core was undoubtedly very much harder than one which was hand rammed. It was very evenly rammed; not hard in some places and soft in others. He had no experience of blowing ordinary moulding sand, but he saw no reason why it should not be blown. As he had stated earlier, the trouble in buying a core-blowing machine was that one had to find out for oneself how to use it to the best advantage. One or two firms were now willing to allow machines to be taken on trial, and were willing to make up equipment for any particular firm, and, moreover, would guarantee that whatever was required to be blown could be blown in one blow.

At the conclusion of the proceedings, Mr. Newman, through the Branch-President, extended a cordial invitation to the members of the Branch to visit his firm's works during the summer of 1938. The London Branch had already accepted an invitation to do so.

Mechanism of Nitride Hardening

A Paper on "The Mechanism of Nitride Hardening" by Dr. M. S. Fisher and Z. Shaw was presented to the Autumn Meeting of the Iron and Steel Institute held at Middlesbrough recently. We append an extract and the authors' conclusions.

Nitriding is carried out by heating a special type of steel in a stream of anhydrous ammonia. The ammonia coming into contact with the surface of the steel dissociates into hydrogen and nitrogen, and a proportion of the latter dissolves in the iron, forming a solid solution of nitrogen in α-iron. When this is saturated, it reacts with more nitrogen to form a constituent known as γ', which in turn reacts with nitrogen to form another phase, ϵ. (There is some evidence that this constituent may finally be converted into another phase, differing only slightly from ϵ but containing more nitrogen. The data on this point are, however, inconclusive.) These two constituents are commonly described as iron nitrides, Fe_4N and Fe_2N respectively, but while the formula Fe_4N corresponds closely to the composition of γ' (5.9 per cent. of nitrogen), ϵ may contain anything from 8.0 to 11.1 per cent., or possibly even more. It is preferable, therefore, not to use these formulæ, though the general term "iron nitride" is permissible. The microstructure of a cross-section through a piece of nitrided iron, cut at right-angles to the nitrided surface, consists of a thin outer layer of ϵ, below which is a duplex region composed of ϵ and γ', the latter constituent increasing in amount until a layer composed of γ' alone is reached. This is followed by a second duplex zone consisting of γ' and α, the proportion of the former decreasing progressively as the distance from the surface increases, until the core is reached. Nitriding, therefore, alters considerably the structure of pure iron, but unfortunately it has little effect on its properties; even in the "nitride" layer, which is the hardest part of the case, the Brinell hardness is less than 200. It is evident, therefore, that the two nitrides, γ' and ϵ, are relatively soft.

If, however, the iron contains elements such as aluminium, chromium and vanadium, the nitrides of which are stable and practically insoluble in α-iron, an intensely hard case is produced by nitriding. The steels generally used for the process are of the type known as "Nitralloy," and contain about 1 per cent. of aluminium, 1.5 per cent. of chromium, 0.25 per cent. of molybdenum, and from 0.2 to 0.6 per cent. of carbon depending on the mechanical properties required in the core. The aluminium is responsible for the greater part of the hardening, but the chromium contributes to this also, and also flattens the hardness gradient below the surface, thus reducing the risk of spalling. Molybdenum is added mainly for the purpose of improving the mechanical properties of the core by refining the grain size.

There has been some controversy about the effect of nitriding on the microstructure of Nitralloy steel. According to the literature, the general opinion is that it is mainly unaltered by the process, the only effect universally observed being that the ferrite matrix of the hardened case etches more rapidly than the core, forming a stained rim, the depth of which corresponds roughly to the thickness of the case. Some workers have observed a network or scattered needles of a white constituent in the outer part of the case, especially in samples annealed before nitriding and in the decarburised layer at the surface of hot-rolled bars. While this Paper was being written, the results of a valuable research by Gunnar Hägg on the structure of nitrided steel were published by the Royal Swedish Institute for Engineering Research. His data were obtained by microscopic and X-ray methods, and show that the two nitrides observed in nitrided iron (γ' and ϵ) are formed also in steels of the Nitralloy type. These nitrides, however, are not generally regarded as essential constituents of nitrided steel, and it is assumed, even by Hägg, that they do not materially affect its hardness. The widely-accepted explanation of the hardness of the case is that it is due to "dispersion" or "precipitation" hardening, caused by submicroscopic particles of aluminium nitride and chromium nitride dispersed through the α-iron matrix of the steel.

Materials

Two Nitralloy steels of the composition given in Table I were used. They differ essentially only in carbon content, and for the convenience of the reader they have been allotted numbers (C3 and C5) representing approximately the percentage of this element in each.

Steel C3 was used as supplied by the makers, in the "heat-treated" condition, *i.e.*, oil-quenched from 900 deg. C. and tempered at 650 deg. C. (Vickers hardness 250). Its microstructure consisted of small islands of ferrite in a matrix of ferrite containing minute carbide globules. As the steel had obviously been quenched at a temperature inside the critical range, it was thought advisable to check the makers' treatment. A sample was therefore rehardened and tempered at the above temperatures, but the structure was found to be unchanged. As this is the condition in which the steel is employed commercially, it was decided not to try to make its structure more homogeneous by changing the heat-treatment. Steel C5 was supplied in the softened condition (Vickers hardness 232) ready for machining. Its structure consisted of minute carbide globules uniformly distributed through a matrix of ferrite. To improve the mechanical properties of the core, the steel would normally be hardened and tempered by the user before nitriding, producing a structure of essentially the same type, but finer. As this investigation was not concerned with the properties of the core, the steel was nitrided as received from the makers.

Table I.—*Composition of Steel Used (per cent.).*

Steel No.	C.	Al.	Cr.	Mo.	Ni.	Si.	Mn.
C 3 ..	0.28	1.08	1.60	0.41	(0.25)*	(0.35)	(0.65)
C 5 ..	0.53	1.36	1.67	0.29	0.25	0.24	0.68

* Figures in brackets are according to the makers' specifications.

From the results the following conclusions have been drawn. A normally nitrided steel is coated with a "nitride" layer (γ' and ϵ) about 0.03 mm. thick, below which is a duplex zone consisting of γ' and ferrite, the proportion of the former decreasing from the surface inwards. In pure ammonia the nitride layer forms in a few minutes at 500 deg. C. It is brittle and spalls when severely stressed The γ'–α aggregate is much less brittle.

The generally accepted explanation of the hardness of nitrided steel (viz., that it is due to "dispersion" hardening caused by sub-microscopic particles of alloy nitrides in α-iron) accounts for the main part of the hardening (up to about 850 Vickers) but iron nitride hardened by dispersed alloy nitrides is responsible for the intense hardness close to the surface.

The rate of nitriding is controlled by the rate of diffusion of nitrogen in the steel. The characteristics of the case produced in a given time at a given temperature are largely independent of the composition of the nitriding gas and of the physical condition of the surface of the steel. Once the nitride layer has been formed, the ammonia can be diluted with about ten times its volume of nitrogen or about one-third of its volume of hydrogen without affecting the efficiency of the process.

Prolonged annealing of a nitrided steel in nitrogen eliminates the visible nitride, and reduces the surface hardness to about 850. Similar effects are produced more rapidly by heating in hydrogen. The hardness below the surface is raised and the case depth is increased by annealing.

Mechanical Properties of Some Tin Bronzes

By Dr. Ing. H. LEPP

Historical

The copper-tin bronzes may be considered as the oldest alloys known to civilisation. They were first used by man about 6000 B.C. Since this time these bronzes have mainly been employed in the cast condition. Nevertheless, it should be noted that even in older times the Romans and Greeks had used worked tin-bronzes. These were probably cold-forged for the production of articles which require a certain degree of hardness, *e.g.*, mirrors, razors, vessels, etc.

The tin content of bronze used for semi-finished products, such as bars, wires and plates, was relatively low—about 5 to 7 per cent. Little change has been made in this respect up to the present time. For cast pieces, such as bearings, valves, etc., the tin content is higher and varies according to requirements from 5 to 20 per cent. of tin.

Equilibrium Diagrams

The first equilibrium diagram of the copper-tin system was determined by Roberts-Austen and Stansfield (1895) and then developed by Le Chatelier, Guillet, Heycock and Neville (1903). These last investigators placed the limit of the solid solubility of tin in copper at about 7 to 8 per cent. of tin. Above this limit the δ constituent (see Figs. 1 and 2), the compound Cu_4Sn, appeared. Westgren and Phragmen have proposed the formula $Cu_{31}Sn_8$ for this compound as the result of a recent X-ray investigation. According to these investigators, this compound crystallises in face-centred cubes with a parameter of 17.9 A. and 416 atoms per unit. The δ constituent is hard and brittle, and has a very unfavourable effect on the forgeability of the alloy, but considerably increases the frictional resistance.

Since these original researches, numerous investigators have studied the copper-tin system, the limit of solid solubility of tin in copper being displaced and increased. After prolonged thermal treatment and by means of X-ray analysis, this limit has been placed by Stockdale and by Westgren and Phragmen at about 16 per cent. of tin. This last figure is of no practical significance and the results of subsequent investigations of this subject are contradictory.

However, the majority of the investigators are now in agreement on one point: that the solid solubility of tin in copper reaches at least 13 per cent. of tin. The present author has shown that this limit can be increased up to 14 per cent. of tin (see Figs. 3 to 5), and can be realised industrially if these bronzes are efficiently degasified. It appears probable that absorbed gases favour the formation of the δ constituent.

TABLE I.—*Mechanical Properties of Cast Tin Bronzes.*

Composition.					Tensile strength. Tons per sq. in.	Elongation. Per cent.	Brinell hardness.
Cu.	Sn.	Zn.	Pb.	P.			
88	10	2	0.5	—	20–23	40–70	70–90
85	8–9	4–6	1–2	—	19–21	35–62	70–75
85	5	5	5	—	18–19	35–47	60–65
90	10	—	—	≤0.1	20–23	40–65	70–80
87	13	—	—	„	20–23	10–20	90–100

FIG. 1.—δ CONSTITUENT. × 1,800.

FIG. 2.—10 PER CENT. TIN BRONZE. SAND CAST (DEGASIFIED). VERY LITTLE δ CONSTITUENT. × 500.

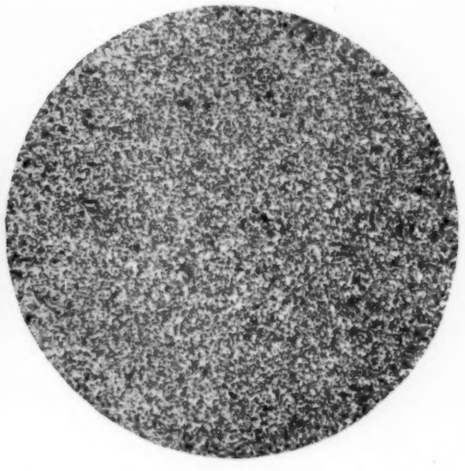

FIG. 3.—12 PER CENT. TIN BRONZE. AS DRAWN. α SOLID SOLUTION. × 85.

In recent times tin bronzes, known under the name of "phosphor bronzes," have been worked for the production of semi-fabricated and fabricated products. These alloys were first manufactured commercially by Ruolz and Fontenay in France (1854), phosphorus being used as a deoxidiser and constituent of the alloy. This type of alloy was then developed by Montefior, Levi and Kunzel (1860) and was introduced industrially into England and the United States on a larger scale by the brothers Dick (1870). Since then these bronzes have occupied a very important place among non-ferrous alloys.

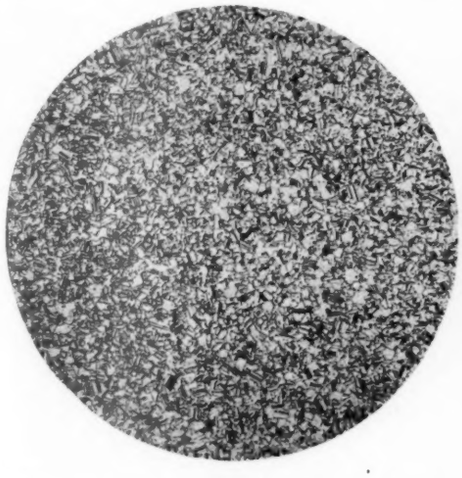

FIG. 4.—14 PER CENT. TIN BRONZE. AS DRAWN. α SOLID SOLUTION. × 85.

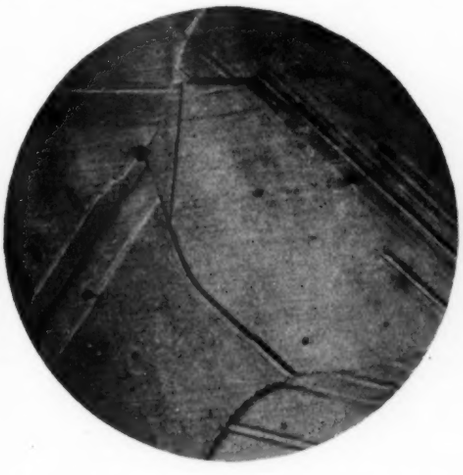

FIG. 5.—14 PER CENT. TIN BRONZE. ANNEALED. α SOLID SOLUTION. × 500.

FIG. 6.—14.5 PER CENT. TIN BRONZE. AS DRAWN. δ CONSTITUENT. × 500.

The crystallographic form of the copper-tin α solid solution is similar to that of copper: face-centred cubic (3.61-3.69 A.) for a tin content of 0 to 15 per cent. In this condition the bronzes are softer and quite malleable, both hot and cold.

Cast Tin Bronzes

In the cast state, the structure of tin bronzes is nearly always in a metastable equilibrium and can be homogenised only by thermal treatment.

Fig. 7.—Torsion Test of Rough Foundry Specimen. 10 per cent. Tin Bronze. Sand Cast.

From the corresponding equilibrium diagrams it is seen that the freezing range is relatively large, about 75 to 200 deg. C., depending on the composition of the alloy. The process of solidification is consequently slow, rather complex and sensitive to external influences. Thus it is very important that the casting temperature, process of solidification of the metal and the conditions under which it is produced (sand or chill, position and dimensions of the feeder heads, etc.) are strictly controlled.

These bronzes in the liquid state have a very pronounced tendency to absorb gas. During solidification, this gas escapes, forms inclusions and intercrystalline porosity, and causes inverse segregation of the alloy. It has been clearly shown that inverse segregation in this group of alloys is in direct relation to the amount of gas dissolved. The structure of the bronzes is heterogeneous in this case and the mechanical properties are reduced to a minimum. Therefore, it is necessary to avoid the absorption of gas during melting, or to degasify the metal. The mechanical properties can be improved very considerably by suitable degasification. The properties of some ordinary bronzes of various compositions in the cast condition are given in Table I.

The charges were composed of virgin metals or quite clean scrap. The casting temperatures were those generally agreed to be the most favourable, *i.e.*, 1,100 to 1,200 deg. C., according to the alloy. The mechanical properties were determined on test-pieces 13.8 mm. in diameter and 100 mm. long, cast in dry or green sand. A diagram of the mould is given in Fig. 8. The specimens were not homogenised. For the types of alloys sensitive to homogenising by heat-treatment, such as the tin bronzes, it is necessary to specify the mould, the dimensions of the test-pieces and of the feeder heads and the casting conditions in order to obtain comparable figures and a more exact idea of the properties of the metal in the cast condition.

Bronzes having a tin content of up to 14 per cent. become perfectly malleable, both hot and cold, after suitable degasification and the mechanical properties in the worked condition are improved. In the latter case their composition is modified; besides tin a secondary constituent is phosphorus (from a trace to 0.3 per cent.); zinc and iron are present as impurities.

The relation between the percentage of tin and the mechanical properties of annealed specimens (13.8 mm. diameter, 100 mm. long) is shown in Fig. 9. The values were obtained under industrial conditions on bars of diameter varying between 20 and 100 mm.; this explains the scattering of the values, especially with regard to the elongation. In addition, an increasing phosphorus content raises the breaking load and the elastic limit, while the elongation is inversely affected, particularly with bronzes rich in tin. As is well known, for the finer sections (*e.g.*, wire from a diameter of 5 mm.) these properties are superior by about 10 to 15 per cent.

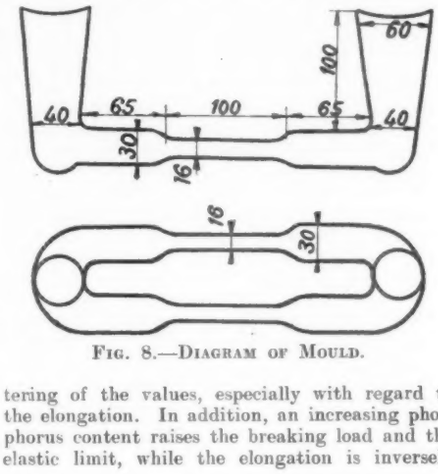

Fig. 8.—Diagram of Mould.

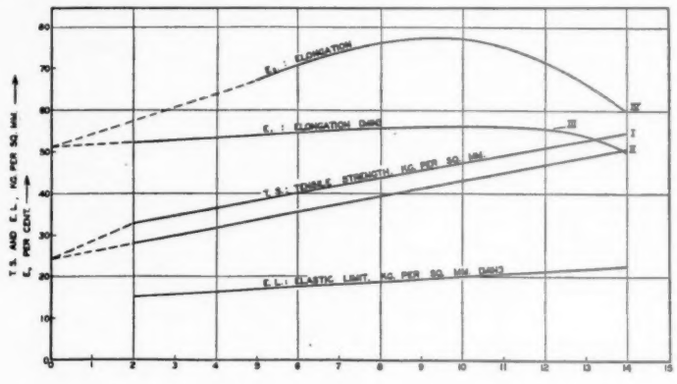

Fig. 9.—Mechanical Properties of Tin Bronzes as a Function of the Tin Content. Tests carried out on Bars 20 to 100 mm. dia. in Annealed Condition. I = P ≥ 0·1 per cent. II = P < 0·1 per cent. III = E_1 on bars ≥ 42 mm. dia. IV = E_2 on bars 20 to 42 mm. dia.

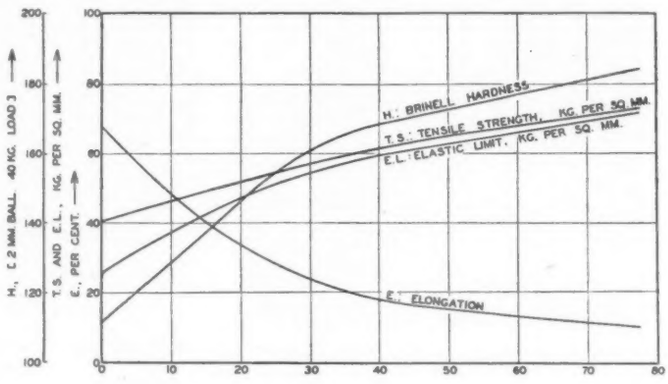
H.: BRINELL HARDNESS
T.S.: TENSILE STRENGTH, KG. PER SQ. MM.
E.L.: ELASTIC LIMIT, KG. PER SQ. MM.
E: ELONGATION
H., (2 MM BALL, 40 KG. LOAD)
T.S. AND E.L., KG. PER SQ. MM.
E, PER CENT.

Fig. 10.—Relation between Mechanical Properties and Degree of Cold-Working of a 6.5 per cent. Tin Bronze.

The reduction in area is about 75-87 per cent. for these alloys. Consequently, the elongation measured on a shorter test-piece, for example the standard English (0.5 in. dia., 2 in. long), is still more superior, say 15 to 20 per cent. Thus the elongation can reach the value of 97 per cent. The impact values of these bronzes in the annealed condition vary from 12.5-13.8 kg./cm.²

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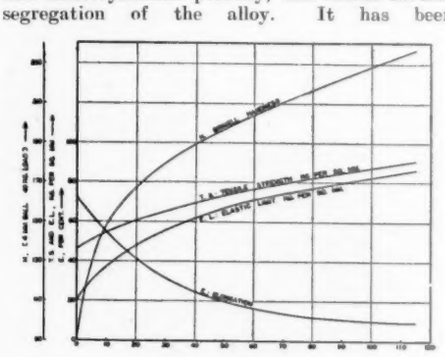


Fig. 11.—Relation between Mechanical Properties and Degree of Cold-Working of a 10 per cent. Tin Bronze.

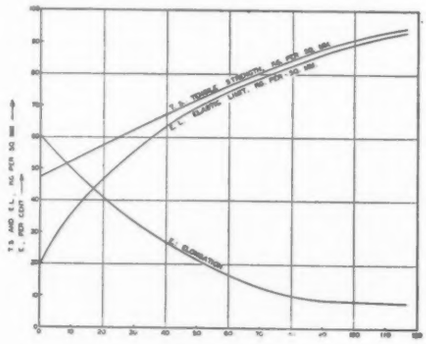


Fig. 12.—Relation between Mechanical Properties and Degree of Cold-Working of a 12 per cent. Tin Bronze.

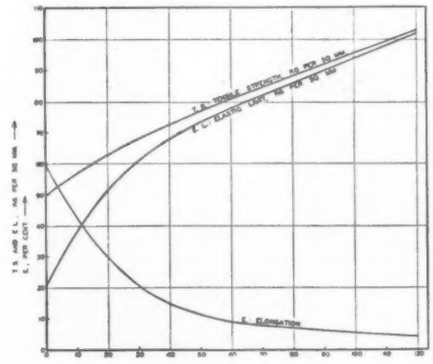


Fig. 13.—Relation between Mechanical Properties and Degree of Cold-Working of a 14 per cent. Tin Bronze.

Non-Metallic Elements in Steel

HYDROGEN, SULPHUR AND NITROGEN

At a meeting of the Staffordshire Iron and Steel Institute, held in Birmingham recently, Mr. T. G. Bamford delivered his presidential address on the subject of "Non-Metallic Elements in Steel." At the outset he referred to practical experiments which had recently been carried out in the Kaiser-Wilhelm Institut, proving conclusively what a devastating effect hydrogen could have upon the properties of steel. Elaborating this fact, Mr. Bamford said it had long been known that nascent hydrogen would diffuse through iron in accordance with Finck's linear diffusion law,

$$dS/dt = kdc/dx,$$

where dS is the quantity of gas diffusing in time dt, and dc/dx is the concentration gradient, while k is the diffusivity constant.

Diffusion of Nascent Hydrogen

It was also known that diffusion of nascent hydrogen would proceed against a considerable pressure of gas on the side of the metal not in contact with the solution. It was, however, only comparatively recently that Bardenheuer and Ploum had observed diffusion through cast steel against pressures of 200 to 300 atmospheres, and it was only at the present time that the principles underlying the theory had been clearly established. Gases diffused through metals in the atomic and not in the molecular state. Only those gases which underwent activated absorption by a metal, involving atomisation, could diffuse through it. In the case of hydrogen and iron, diffusion was a lattice process, and the grain boundaries played no part, except perhaps that they provided active centres for absorption and facilitated the entry of the gas. Diffusion resulted from the successive formation of unstable gas-metal associations, the gas-metal being handed on from one atom to another. Whenever it passed into a contraction cavity, a blowhole or non-metallic inclusion, it became converted into molecular hydrogen, in which form it could not diffuse and would develop many thousand atmospheres pressure within the metal. The same development of internal stress would develop within the metal, if for any reason atomic hydrogen which was diffusing through it or was dissolved in it, was caused to combine with another atom, forming molecular hydrogen or a hydrogen compound with another element. Pickling blisters, surface defects on galvanised sheets, scale markings on enamelled sheets, hydrogen brittleness after soldering and gas welding were well-known examples of faults, traceable to the formation of molecular hydrogen under pressure. If, for example, steel which had absorbed hydrogen in the pickling bath was allowed to come into contact with molten brass, as was usual in the brazing of steel parts, the sudden increase of pressure due to the heating of the entrapped gas, disrupted the metal, creating intercrystalline fissures through which the molten brass was enabled to penetrate, and a defect known as brazing brittleness was the result. Even with low-carbon steels, absorption of hydrogen gas from acid solutions caused a sharp decrease in deforming qualities and steels containing 0.90 per cent. carbon became quite brittle like glass. Plasticity could, in part, be restored by heating to a red heat, at which temperature ionisation of the gas at the metal surface took place to an appreciable extent, and the gas diffused slowly through the metal, escaping into the atmosphere.

Since it was only atomic hydrogen which could dissolve in molten steel, and since it was only at high temperatures that molecular hydrogen was ionised or converted into atomic hydrogen at the metal surface, it followed that molecular hydrogen had no solubility at room temperatures, so that its solubility in steel decreased rapidly with fall of temperature. The gas taken up in the annealing furnace by steel from gas mixtures containing hydrogen would, if retained in it by rapid cooling, create intense internal stresses with resultant deterioration of properties. Gas taken up in this way had therefore essentially the same influence as gas absorbed in the pickling process. There was the difference, however, that the gas could escape if cooled slowly from the temperature at which it was absorbed and little harm would result, unless the dissolved gas was expelled too quickly.

Nickel-Chromium Steels

Nickel-chrome steels with about 1.0 per cent. chromium and 3 per cent. nickel seemed to be susceptible to damage by hydrogen gas taken up by the molten metal. From melts of this alloy treated like the straight carbon steels, Bardenheuer prepared forged plates 10 mm. thick from the first heat and also at forging temperatures of 1,000 deg. C., and 1,250 deg. C. The untreated steel was quite sound but, whether forged directly or after cooling and forging at 1,000 deg. C. or 1,250 deg. C., the metal which had been subject to hydrogen treatment showed splinter flaws easily discernible in the plates after nicking and fracturing.

On the basis of his experience, the steelmaker laid great weight on a sufficiently long boil since he knew that, failing this, a steel with bad properties would result. Particularly was it the case that a brittle steel could only result when large quantities of strongly-rusted scrap had to be worked in and when a high carbon content had to be held and a long boil must be avoided. Rust differed from pure iron oxide essentially through its content of occluded hydrogen, and in fact a 1 per cent. addition of rust introduced 2.5 cub. m. of hydrogen per ton of steel or measuring the gas at N.T.P., a volume equal to twenty times the total volume of the steel. Unlike hydrogen, carbon monoxide was almost insoluble in iron and steel. A lively boil was therefore effective in driving out the greater part of the hydrogen from the bath. The carbon monoxide, bubbling through the bath of metal, created in the bath itself and in the atmosphere above it an atmosphere of carbon monoxide in which the partial pressure of the hydrogen was practically zero, so that the higher the pressure of this gas in the steel bath as against the smaller partial pressure in the surrounding atmosphere, induced a tendency for the hydrogen to pass from the former into the latter. In that way the dissolved hydrogen was slowly removed from the bath, and in whatever way it had passed into it at some stage of the process, it should be possible to remove it if a sufficiently long boil was possible.

Consequences very detrimental to the properties of the steel could result, however, from the introduction of hydrogen by additions made to the finished bath at a time when no further boil was possible and the injurious gas could not be removed. For example, a steel was often spoiled by the addition at the finish of the heat of damp lime or ferro-alloys containing hydrogen. Most ferro-alloys held considerable quantities of this gas, which was taken up by the bath, if the temperature was high. This was found even with transformer steels containing 4 per cent. silicon, if the steel was alloyed with ferro-silicon in the ladle. Keil and Czermak had shown that the surface blisters which were essentially due to hydrogen completely disappeared if raw limestone was used instead of the burnt product. Burnt lime would take up, on standing, 10 per cent. or even larger quantities of water, and in this way introduced large quantities of hydrogen into the bath. The unburnt limestone, on the other hand, carried very little moisture and through its content of carbon dioxide further stimulated the boil and the degassing of the bath.

Removal of Sulphur

The author then referred to sulphur and its removal from steel, and said that it had been shown that sulphur existed in liquid iron as a sulphide whose molecule contained one atom of sulphur and whose formula may be written as FeS and any method for desulphurising the bath must take cognisance of the reactions which could take place with this compound. Hydrogen present in a steel bath would interact with FeS forming H_2S but, at steel melting temperatures, working with metal containing 0.30 per cent. sulphur the reaction stopped when the ratio of hydrogen to hydrogen sulphide was almost 7,000 to 1 by volume. Removal of hydrogen from a molten steel bath did, therefore, simultaneously remove sulphur, but since 10 lbs. of hydrogen per ton would only carry away about 0.01 per cent. sulphur from a steel containing 0.30 per cent., or 0.02 per cent. from one with 0.60 per cent., it could not be regarded as an effective agent for the removal of sulphur. On the other hand, if hydrogen was left in molten steel the amount of H_2S which would be associated with it may be very harmful. Since H_2S was quite insoluble in the solid metal it would inevitably be responsible for dirty blowholes.

The desulphurising powers of basic slag were due to reactions in which a basic oxide in the slag reacted with iron sulphide in the metal to form iron oxide and a more stable sulphide. There was some evidence to show that lime was the most powerful desulphuriser with MnO second and MgO a poor third. It was not, perhaps, so widely realised that the affinity of some metals for sulphur was so great that under proper conditions it should be possible to effect a marked reduction in sulphur content by addition of the metal itself. It was well known that manganese would decrease the sulphur content of high-sulphur pig-iron by forming manganese sulphide which was thrown out of solution with the kish. In the open-hearth, however, the desulphurising power of manganese was offset by the reaction of its sulphide with FeO to form manganese oxide and was equivalent simply to that produced by a concentration of MnO in the slag which would be in equilibrium with manganese in the metal. By reason of the relatively smaller amount and lower desulphurising power of MnO than CaO in the normal slag they must conclude that the influence of manganese as a desulphuriser in the open hearth was far less important than that of lime. Calcium and also magnesium formed stable sulphides. The metals were gases at the temperature of liquid steel and their solubility in the bath was quite limited.

If enough excess calcium or magnesium was added to saturate the bath and since the solubility was limited, this would be a small amount, then their partial gaseous pressures would be one atmosphere, and the percentage of FeS was equal to the values of the constants. Thus the sulphur present as FeS was reduced to 0.0045 per cent. by the magnesium and 1.8 by 10^{-6} per cent. by the calcium reaction. Theoretically it was possible to remove sulphur from an oxidised bath by melting in vacuum and pumping off sulphur dioxide. With a sulphur content of 0.02 and iron-oxide content of 0.36 per cent., the pressure of SO_2 was about 0.002 mm. A vacuum, such as this, attainable for small laboratory melts was scarcely to be considered for practical purposes. With less powerful suction the sulphur remaining in the steel would be correspondingly higher. Of the three new methods suggested for the desulphurisation of steel, the use of magnesium or calcium seems to warrant further consideration.

(*Concluded on page* 326.)

Sources of Information

DR. EVEREST'S PRESIDENTIAL ADDRESS

The London Branch of the Institute of British Foundrymen held the first meeting of its new session at the Charing Cross Hotel, London, W.C.2, last Wednesday. Mr. V. Delport (retiring Branch-President) presided at the opening of the proceedings. On the motion of Mr. C. C. Booth, J.P. (Branch Vice-President), seconded by Mr. A. R. Bartlett (Past Branch-President), the minutes of the previous meeting, held on April 7, 1937, were taken as read and were confirmed and signed.

Mr. Delport took the opportunity to thank members of Council and the members of the Branch generally for their generous support during his year of office as Branch-President. He also thanked Mr. H. W. Lockwood particularly for his very great assistance as Branch hon. secretary, which office he had resigned, and was succeeded by Mr. R. Causebrooke. Mr. Delport assured the members that his year of office had been of great interest and that he had been greatly honoured to have been asked to serve as Branch-President.

Induction of New Branch-President

Mr. Delport, welcoming his successor, Dr. A. B. Everest, said that in view of his large experience of meetings, his wide connections and his knowledge of cast iron, he would undoubtedly prove to be a very worthy President. It was a real pleasure to invite him to occupy the Chair and on behalf of the Branch Mr. Delport wished him a very interesting and successful period of office.

Dr. Everest formally occupied the Chair amid applause.

In the first place he expressed his appreciation of the honour and said he hoped to fulfil with satisfaction the many duties which his office involved. Thanks to Mr. Delport, he added, the past session had been excellent, and with the active co-operation of all the members of the Branch he looked forward to an equally successful session. He commented upon the increasing tendency towards the holding of joint meetings, as indicated by the programme for the session. There were joint meetings during the session with the Birmingham Branch, the London Section of the Institute of Metals, and with the Institute of Vitreous Enamellers, and he asked for the support of all Branch members, particularly at those joint meetings with other bodies, in whose activities they had a close interest. Dr. Everest then delivered his Presidential Address as follows:—

Specialised Knowledge

The problem of bridging the gap between the research worker in his laboratory and the practical foundryman is one which is constantly before all the members of this Institute. Many of my predecessors in the Presidential chair have laid emphasis on this problem and have discussed from various angles the important *rôle* played by the Institute in bringing together the research man and the practical worker and acting as a clearing ground for the information gathered from the laboratories and making it palatable and acceptable to industry. As is well known, this *rôle* is fulfilled partly by the activities of the Technical Committee, about which Mr. Gardom is speaking later this evening. It is also fulfilled in a large part by the presentation and discussion of technical Papers, and also, to an important extent, by the social interchange of ideas among members at meetings, congresses and other gatherings. The Institute may thus justly claim to be one of the corner stones of British foundry practice to-day, and as such it demands the respect, and is worthy of the fullest possible support, of every progressive foundryman.

By its activities, indicated briefly above, the Institute may fairly be said to act for the assimilation and dissemination of information. Certain types of information are, however, of a more specialised nature than would normally come under discussion at technical meetings, and it is on this question of specialised information that I propose briefly to address you to-night.

In the last ten or fifteen years remarkable progress in all branches of foundry activities has been seen, and a great deal has been done to establish foundry practice on a truly scientific basis. This, in turn, has been reflected in a greatly increased production of new alloys, with an ever-widening range of physical properties. Incidentally, it is also reflected in a general improvement in normal foundry practice, with consequent improvement in the properties of the regular and more common foundry products.

American Foundry Practice

I have just returned from the United States, where I was privileged to meet many of the leading foundrymen in all branches of foundry practice and to visit plants manufacturing a wide variety of products, from 50-ton cast-steel locomotive frames down to automobile shops where the output of castings runs into millions per day, in forms ranging from 2 ozs. up to 2 cwts. apiece. I also visited jobbing shops producing castings of all sizes up to 30 tons in weight, with a regular tensile strength of 27 tons per sq. in. or over. Time does not now permit me to enlarge on my experiences in the United States, but I hope shortly to be able to give some more coherent impressions of my tour. One outstanding fact, however, which is related to the subject of this address is that in the United States there is a greater diversity in melting practice, use of alloys and special materials generally than is found in this country, and there is no doubt that as the demand arises certain features of present American practice will of necessity be absorbed into industry on this side of the water. The development of these special processes and the use of the particular materials involved all depend in the first place on the availability and the application of specialised information.

A number of modern developments in foundry practice involve the use of special materials, either as alloys or in plant construction, and a great deal of the specialised information of the type I have in mind relates to the properties and use of these materials. It is therefore only logical to find that the producers and suppliers of these materials have as a matter of normal business routine themselves undertaken to provide the specialised information required for the development and use of their products.

It is in this manner that development associations or bureaux of information have been established for many of the commoner metals used in industry.

To-day there are the well-known centres of information in connection with aluminium, copper, nickel and tin and to a lesser extent in connection with molybdenum, zinc, cadmium and lead. It might also be mentioned that in other industries related to the metallurgical field similar activity is found, as for example in connection with refractories, coal, coke, gas and other fuels.

Each of these technical centres collects and classifies all the available information concerning the particular product in which it is interested, whilst in many cases information on related products is also similarly noted. Each of these centres thus becomes a focal point for specialised information on its own subject, with staffs willing and anxious to supply information and assistance freely to foundrymen or other users of their products.

Bureaux of Information

I may perhaps be forgiven for referring in this connection specifically to the nickel industry, with which I am associated. This industry has to a large extent been a pioneer in the matter of research and development as a means of providing the practical man with that specialised information necessary for the use of this particular metal. In this industry, the period after the Great War found the producers with a productive capacity far in excess of the then established peace-time uses of the metal, and in order to provide new outlets, a systematic policy of research and development was instituted. This policy has been steadily pursued and has unquestionably been successful in opening up new and unexpected markets for the metal. To-day the nickel organisation has laboratories established in various parts of the world where fundamental research on nickel and its alloys is conducted. In addition, it has instituted in several countries of the world departments the function of which it is to apply the results of this research to industrial problems and at the same time to provide information to industry on every aspect of the application of the metal.

A special section of our own organisation is devoted to the collection and classification of published information on nickel and its alloys and on related materials. For this purpose, regular searches are made of the world's technical publications and patent literature. Some idea of what this involves may be gathered from the fact that in our London office alone some 250 regular technical periodicals are consistently searched and all items of interest recorded. At the present time the number of cards on our reference files is in the neighbourhood of 300,000. By such a system of collecting and indexing data it is possible to supply at short notice any existing information even on the most remote problems connected with nickel and its alloys.

The example of the nickel industry is given merely as typical of that of the centres of information which are now being set up by the various producers of the metals mentioned earlier in this address. In each of these centres, specialised publications and bulletins are prepared from the sources of information studied and are sent out to all interested. Further, in most cases practical assistance is given by means of works visits and personal contact to those in any sort of difficulty, either in the development of special alloys or in the solution of technical and industrial problems.

In this manner each of these technical centres has now become a source of specialised information to which the practical man can turn in difficulty or need.

At some time or other one is confronted with the problem of obtaining specialised information. I do not wish to elaborate this part of my subject at the present time, since later in the Session Mr. Faulkner has promised to give you a short talk on this very subject. A suggestion which I would make, however, is that in addition to the specialised bureaux of information mentioned, more use could and should be made of the research associations connected with the industry. Each of these research associations maintains as part of its normal work a library and information bureau from which specialised information can be drawn, and in this connection many of you have no doubt already made use of the British Cast Iron Research Association and the British Non-Ferrous Metals Research Association. Thus, suppose a foundryman were asked to quote for castings in some remote alloy, say, for example, in cast iron alloyed with a few per cent. of cadmium, he would naturally require further information as to the influence of cadmium on cast iron, and as to the forms in which it is available and should be added, and so on. For this specialised information the foundryman should turn immediately to the B.C.I.R.A., in whose library any published information on the influence of cadmium would be available. On the other hand, he might in turn

approach the suppliers of the special metal cadmium, who may or may not be in a position to give him the necessary help.

ASLIB

This brings me to my next point, namely, that it is of special interest to know that all the various sources of specialised information have been bound together in various ways into central organisations which form, as it were, clearing houses for information and data. One such central organisation is that known as ASLIB (The Association of Special Libraries and Information Bureaux), which, as its name implies, aims to bind together specialist sources of information. ASLIB was founded in 1924 as an unofficial body, an association of organisations and individuals whose interests lie in the collection and dissemination of information. Membership involves a small fee, and among its many supporters are included learned societies and research associations, professional and trade associations, industrial and commercial concerns, public libraries, University organisations and Government Departments, and private individuals. It will be appreciated that the technical interests covered by such bodies include a very wide range of subjects. The objects of the Association are to encourage co-ordination of the activities of the individuals and organisations represented in its membership, to act as a clearing house for sources of information and to promote, by conferences, correspondence and other means, the systematic collection and wider dissemination and use of special information. A further important aim of the Association is to direct effort, as indicated above, towards the elimination of waste of time and energy due to unnecessary duplication of research work.

ASLIB organises an annual conference at which the problem of the dissemination of information is discussed It maintains an inquiry bureau for members seeking special information and further assists members in obtaining translations of Papers in foreign languages.

National Central Library

Another important and useful central organisation for information is that which is now known as The National Central Library. It is, of course, only to be expected that if a particular book or if special information is required one should approach the nearest public library. In many cases, owing to lack of demand, it is probable that the public library will not actually have in stock the necessary information or literature. Every library, however, can draw for special information on the National Central Library which acts as a clearing house for literature from various public and some specialist libraries in the country. The activities of the National Central Library are on a very large scale and associated with it are some 166 "outlier" libraries, as they are called, which include specialist libraries both of a public or non-public character. It is perhaps important where some special information is required to know of the existence of this organisation, from which even rare books and other publications may be obtained.

In addition to the centralised organisations mentioned above, a number of very good *resumés* on foundry practice and foundry alloys appear from time to time in the technical press and it is frequently useful to know of these so that ready reference may be made to them without loss of time. Such mines of information are, of course, available in the Proceedings of the technical institutes including, in addition to the Institute of British Foundrymen, such institutes as the Iron and Steel Institute, the Institute of Metals and so on, the high quality of whose abstract services is well known. In addition to the publications of these institutes, very good *resumés* on foundry practice and materials are published from time to time in such technical journals as "Stahl und Eisen," or reviews on different aspects of cast iron metallurgy are published in many other journals, as for example the Journal of the American Welding Society, which has recently issued a review of the literature on the welding of cast iron. Other information is available in the symposia published under the joint auspices of the American Foundrymen's Association and the American Society for Testing Materials on such subjects as malleable iron castings, cast iron and alloy cast irons. The Engineering Foundation is also sponsoring a complete investigation on iron and its alloys, in connection with which a number of monographs have already been published. These include alloys of iron with silicon, molybdenum, tungsten and copper, whilst further volumes in preparation will deal with alloys of iron and chromium and nickel and manganese.

There are, of course, a number of other sources of information, amongst which we must not forget the Patent Literature of the various countries, which are readily available to the individual worker. The above examples, however, will serve to show that information is easily accessible to those who are willing to take the trouble to seek it out for themselves.

The question of keeping abreast of technical development is a problem for all. I hope, however, that I have been able to show you in this address that there are in existence centres and organisations for the collection and dissemination of information on which you can all draw as necessity arises. Most of these centres exist to help when information is required, on even the most abstruse subjects. As industry advances the individual workers are faced daily by new problems and although the question of specialised information may not be of vital importance to you individually to-day, there is no doubt that at any time the occasion may arise when you will require such specialised knowledge and then it is at least a comfort to know that there are these national and industrial organisations to which you can turn for assistance.

Vote of Thanks

Mr. C. C. Booth, J.P., proposed a hearty vote of thanks to Dr. Everest for his Presidential Address, to which he referred as magnificent. He also took the opportunity to thank Dr. Everest for his hard work in connection with the arrangement of the session's programme, and said that, given the support which he deserved, he would render great services to the Branch and the Institute.

Mr. C. H. Kain (Past-Branch-President) seconded. He recalled the view put forward by Dr. Samuel Johnson to the effect that there were two kinds of knowledge, that which one knew and that which one could find if it were required. Dr. Everest had shown how to find knowledge when it was required, and his address would prove to be very valuable. The vote of thanks was carried with acclamation, and the Branch-President briefly responded.

The Institute's Technical Committee

Mr. J. W. Gardom (the Convener of the Technical Committee of the Institute) discussed the activities of that Committee, the function of which is to deal with technical problems arising within the Institute and between it and other bodies. He recalled that eight years ago, when he was President of the London Branch, there had been a discussion on means of helping the Institute and the Branch, and during that discussion the formation of a Technical Committee was suggested. In 1930 the matter was put before the General Council of the Institute, the Technical Committee was formed, and it held its first meeting at Gloucester in 1931.

One of the first tasks the Committee had undertaken was the examination of specifications with a view to their standardisation. For that purpose the Committee divided itself into sub-committees. The first was the Malleable Iron Sub-Committee, which collected and examined all the specifications relating to malleable iron, and subsequently produced a report on the matter. The object was to bring those specifications down to a common base and then to arrive at one specification.

Later a Sub-Committee on Sands had produced a report on routine methods for testing green sands, which represented an effort to introduce some standardisation into sand testing. It was presented at the Cardiff Conference of the Institute; so far as standardisation was concerned, it was a great success, and many of the recommendations of the Sub-Committee had since become considered as standard. That Committee had since produced a report in which methods were recommended for the routine testing of dry sand and loam. The next report was by the Cast Iron Sub-Committee, dealing with total carbon and phosphorus in relation to porosity and the strength of cast iron. That Committee had done some very good work in the direction of introducing some standardisation into specifications. From it there had developed a new specification, which was not yet published, but in the near future he believed it would be published as a new B.S.I. cast iron specification, No. 321; and a new high-duty cast iron specification. The Sub-Committee could approach their work on the B.S.I. Committees with uniform ideas, and he believed the cast iron specification had passed through the B.S.I. faster than any other previously produced.

The next report was by the Non-Ferrous Metals Sub-Committee, containing recommendations in respect of two leaded gunmetals, and was presented to the Glasgow Conference of the Institute. The object of that publication was to secure criticisms and then to consider a new specification, and the matter was under consideration by the B.S.I. Another report presented to the Glasgow Conference was produced mainly by the Malleable Iron Sub-Committee, and dealt with dimensional tolerances for castings. That had dealt with a small part of the Malleable Iron Sub-Committee's report as presented four years previously, a fact which indicated the immense amount of work which the Sub-Committees had to do.

Then at the Derby Conference recommendations were put forward by the Costing Sub-Committee on the establishment of costs in the grey iron foundry. The reports presented, which had averaged one a year since the Technical Committee was first formed, represented the unanimous views of the Sub-Committees after detailed discussion. He emphasised that the men engaged on that work were doing it in their own time and at their own cost.

Another function of the Technical Committee was the dissemination of knowledge obtained by the academic man, who might be termed the research worker, to the foundryman in practical form; the technicians on the Technical Committee did provide a very effective liaison between the academic man and the foundryman. At the same time, Mr. Gardom emphasised that the Technical Committee had no facilities and no right to do research work itself. Still another activity was that of the inquiry bureau, to which founders could submit their difficulties and could be assured of advice which was fully considered before it was given. The Committee had dealt with some sixty or seventy queries.

Another valuable feature was that the Technical Committee was a Standing Committee to put forward the considered views of the Institute on matters submitted by the B.S.I., and it appointed representatives on B.S.I. Committees. The members of the Technical Committee numbered sixty-six and the Institute, through the Technical Committee, had a better representation than it had ever had before. Again, representatives of the Institute, working through the Technical Committee, were always present at meetings of the International Committee on testing cast iron. The Technical Committee also had representatives on the Continental Committee which was preparing an international dictionary of foundry terms; there was an assurance, therefore, that the equivalent English terms would be given adequately. Another International Com-

mittee was considering the publication of a list of foundry defects, and there again the Technical Committee had been invited to co-operate.

The gift to the Institute of £500 from Mr. C. W. Bigg and his co-directors, to commemorate Mr. Bigg's Presidency, and which had been announced at the Conference in Derby this year, was intended to be used mainly for technical purposes. Any suggestions as to how that money could most usefully be spent would be welcome.

Mr. Gardom also took the opportunity to thank the London Branch particularly for its support of the work of the Technical Committee. Thirteen of the Branch members were working on the Committee, and three of them were Conveners of Sub-Committees—Mr. C. H. Kain (Malleable Iron and Steel Sub-Committees); Mr. V. Delport (Costing Sub-Committee) and Dr. L. B. Hunt (Non-Ferrous Sub-Committee). It could also be claimed that some of the junior metallurgists, by reason of their work on the Technical Committee, had come to realise that their first ideas were not always the best. The work had taught them a little patience and the owners of foundries had a better class of man to pick from by reason of the training which the work of the Committee afforded. A further valuable outcome of the work was that it had brought competitors together to discuss their mutual problems, to the advantage of the industry as a whole, without any breach of confidence with regard to their firm's work.

Discussion and suggestions were invited with regard to the work of the Committee. A matter which was dealt with particularly was Mr. Gardom's plea for fuller discussion and criticism of the Reports produced by the Committee. It was pointed out in the course of discussion that inasmuch as the reports were so carefully considered before they were presented, they afforded little ground for criticism. Another suggestion was that it was difficult to absorb fully the contents of such a report when it was presented for the first time to a meeting of the Institute or of any of its Branches, and therefore it would be a good thing to publish the reports in pamphlet form shortly after they were delivered, and then to submit them for further discussion at a later meeting.

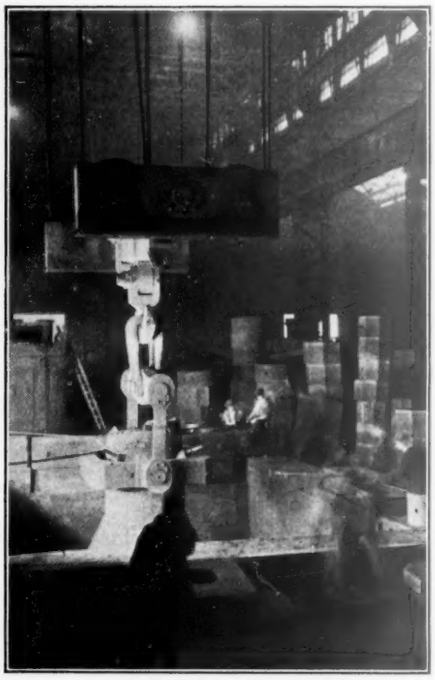
MR. GARDOM said the Committee had endeavoured to meet that point by presenting reports at the Annual Conferences of the Institute and then presenting them again at Branch meetings. Some quite good discussions and suggestions had resulted.

On the proposal of MR. BARRINGTON HOOPER, C.B.E. (Branch Vice-President), seconded by MR. C. H. KAIN (Branch-Past-President) a hearty vote of thanks was accorded Mr. Gardom for his address, and particularly for his virile leadership of the Technical Committee, the work of which was applauded by all as of great value, although, as was pointed out by Mr. T. Makemson (General Secretary of the Institute), it could not be spectacular.

A 230-Ton Ingot

LARGEST PRODUCED IN GREAT BRITAIN

Not many years ago the production of a steel ingot weighing 100 tons was looked upon as somewhat of an achievement. The advances and changes in heavy engineering and the demands of the engineer and designer in connection with some of the more recent schemes they have evolved, have had to be met by the steelmaker, with the result that in 1932 English Steel Corporation, Limited, at their Vickers Works, produced the largest ingot that had ever been made in this country—175 tons. They have now gone a step further and produced a steel ingot of 230 tons in weight, approximately 25 ft. long by 10 ft. across corners. This ingot, which was made in a chilled mould, is the largest ever made in this country. It necessitated the use of four acid open-hearth furnaces which had to be carefully worked to bring the bath of the furnace in each case to the desired condition at a definite time so that pouring, which was done through the first ladle, was uninterrupted.



WITHDRAWING INGOT FROM CASTING PIT.

CHARGING INGOT INTO REHEATING FURNACE.

The ingot, which is being made into large forgings in connection with the Government defence programme, will be brought to forging temperature in a reheating furnace prior to forging under a 7,000-ton press, the largest forging press of its type in the world, which can deal with ingots of 300 tons in weight.

Correcting the Deformation of Large Cast-Iron Machine-Tool Frames

Writing in "Liteinoe Delo," No. 4, 1937, S. L. SKOROMOKHOV states that large cast-iron machine-tool frames which are slightly curved in the direction of their length may be straightened by supporting the frame horizontally at its ends with the curvature directed upwards, and loading it in the centre. A clearance amounting to two or three times the amount of the original "sag" is left below the centre of the frame. The casting is then heated for an hour at 750 deg. C., after which it is removed from the furnace. The curvature is then opposite in direction to the original curvature, but as it cools, the casting straightens out to the necessary extent.

In certain parts of grey iron castings, skins or films of hard white iron are sometimes formed and render subsequent machining difficult if not impossible. They may be removed by heat-treatment employing mill scale. The affected areas of the castings are covered with mill scale, and the castings are heated for three to six hours at 940 deg. C. The hardness of the white iron skins is thus reduced and the machining of the casting is rendered possible. On the other hand, certain portions of large castings sometimes possess insufficient hardness. This may be remedied by heating the casting for 40 or 80 mins. at 840 deg. C., removing it quickly from the furnace and chilling it by spraying with water, the latter being, of course, prevented from reaching thin parts of the casting.

Non-Metallic Elements in Steel

(*Concluded from page* 323.)

Effect of Nitrogen

Referring to nitrogen, the author said that strictly speaking, nitrogen was incapable of dissolving in any solid metal in the same way that hydrogen dissolves in iron. It could only form nitrides such as Fe_4N which could themselves form solution with the metal. The absorption of molecular nitrogen by iron took place only slowly, unless the surface had been activated which may occur in service as the result of abrasion, when the resultant hardening of the surface had been known to lead to failure. As was well known, nitrogen was more readily absorbed if the metal was heated in ammonia, which decomposed at the metal surface. Since the process was essentially one of nitride formation and not of simple diffusion of the atomic nitrogen, it followed that when a layer of the higher nitride Fe_2N had formed on the surface of the metal, the rate at which nitrogen penetrated further was governed by the rate with which the solid phases reacted and not by the composition of the gas enveloping it. Thus, Fisher and Shaw had shown recently that the presence of 80 per cent. of nitrogen in the gas did not impair the efficiency of the nitriding process. Dilution of the ammonia with hydrogen reduced the depth of case, but after the nitride surface layer had been formed, by even a few minutes treatment with ammonia, a dilution of one-third of its volume with hydrogen had no effect. Larger additions of hydrogen reversed the nitriding process, the nitrides being decomposed.

Combination Pattern for Moulds

V. M. ANDREYEV, writing in "Liteinoe Delo," No. 4, 1937, states that very little attention is paid in the literature to patternmaking for the making of large iron castings, yet the production of patterns and core boxes is one of the decisive factors in determining the cost of castings. A considerable saving in time and material is secured, for example, by the use of a combination pattern for moulding a support for a water turbine.

Recommended Methods for Testing Dry Sand and Loam

After Mr. H. J. Roe had delivered his Presidential Address at the opening meeting of the winter session of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, on October 1, Mr. J. J. Sheehan was invited to read some recommendations of the Sands Sub-Committee of the Technical Committee of the Institute, on "Methods for Testing Dry Sand and Loam." These are printed below.

Sampling

The sample of sand to be tested (sufficient for all tests) should be placed in a receptacle with a well-fitting lid and covered with a damp cloth or piece of sacking.

Preparation of Test Specimens

(*a*) *Size of Test-Piece.*—The standard A.F.A. test-piece, 2 in. dia. and 2 in. long, gives satisfactory results, and in view of its adoption for the testing of green sand it is recommended for dry sand and loam testing.

(*b*) *Ramming the Test-Piece.*—Dry Sand: This can be conveniently rammed by means of the standard A.F.A. drop rammer, as used for green sand. Loam: Test-pieces are difficult to make in this material, which cannot be rammed on the drop-rammer, and are best formed by using a core-box lined with greased paper. It is advisable to make the test-cores in the form of round bars, say 2 in. dia. and 6 in. long, and then to cut into 2 in. lengths after drying. A very convenient way is to use a series of brass tubes having the inner face covered with grease paper. The loam is worked into position by a metal rod to free it from air-bubbles, and the cores can be easily ejected by the fingers after partial drying.

Drying of Test-Pieces

Dry Sand.—The temperature of drying should not exceed that at which the sand begins to lose dry strength. Some sands decrease in strength on heating below 200 deg. C., and it is recommended that tests should be made at various temperatures between 150 and 250 deg. C. to find the most suitable drying temperature. The time in the stove should be such as to effect complete drying. On the average, a time of 1 hr. at 190 to 200 deg. C. should suffice for ordinary specimens when placed in a hot oven.

Loam.—Test-pieces must be very carefully and slowly dried if reliable results are to be obtained. It is recommended that the green test-cores should be allowed to dry for 24 hrs. in the core-box at a temperature not exceeding 50 deg. C., and then transferred to the stove for complete drying at 200 deg. C. after removal from the core-box or tube. Unless this procedure be followed the test-cores are liable to be full of cracks and blemishes, giving unreliable results.

Conducting Dried Compression Strength Tests

All cores should be tested immediately they have cooled down to room temperature, in a suitable apparatus which should be capable of applying a steady load in compression increasing up to a maximum of 500 lbs. per sq. in. A convenient and inexpensive machine is that after the Buchanan design, for which the following gauges are recommended:—

(1) Range: 0 to 25 lbs. per sq. in. (or 0 to 250 lbs. load on specimen).

(2) Range: 0 to 100 lbs. per sq. in. (or 0 to 1,000 lbs. load on specimen).

(3) Range: 0 to 500 lbs. per sq. in. (or 0 to 5,000 lbs. load on specimen).

Many types of testing machines for carrying out tensile or transverse tests are capable of being adapted for the compression tests, and *vice versa*.

The *Dry Compression Strength* is expressed in lbs. per sq. in. obtained by dividing the total crushing load in lbs. by the area of the specimen,

$$i.e., \quad \frac{Crushing\ load\ in\ lbs.}{3.142} = \text{lbs. per sq. in.}$$

Conducting Dried Permeability Tests

All cores should be tested, immediately they have reached room temperature, on the standard A.F.A. apparatus (or that modified by Richardson), by using the standard A.F.A. mercury-seal attachment. When Richardson's apparatus is used for testing the permeability of loam it is important to use the $\frac{1}{16}$-in. jet, otherwise the liquid in the manometer tube will be blown out.

The *Permeability Number* is given by the expression:

$$\frac{30{,}072}{\text{gms. pressure} \times \text{secs.}}$$

as given in the Sub-committee's recommendations on "Green Sand Testing, Appendix A."

Mr. G. R. Shotton followed the presentation of the recommendation with a brief account of the lines on which various Sub-committees are working.

Mr. Sheehan and Mr. Shotton were thanked for their contributions, on the proposition of Mr. A. Tipper, seconded by Mr. J. Hird. Mr. Tipper mentioned that an effort was being made to standardise sand testing apparatus internationally.

William Wilkinson

Mr. F. O. L. Chorlton, M.I.Mech.E., in his Presidential Address to the Manchester Association of Engineers, traced the history of engineering and mechanics from the earliest times. When dealing with the 18th century Mr. Chorlton referred to the bulk of modern foundry practice in the following terms:—

The last 40 years of the 18th century and the early years of the next were prolific of inventors and important inventions. The John Wilkinson who invented the boring machine in 1775 also applied a steam cylinder to operate a drop hammer and made rolling mills, coining presses and draw benches. He was a great believer in cast iron and was buried in a cast-iron coffin. History does not tell us how he was carried to his last resting place but no doubt his ingenuity had arranged for some method of mechanical transport. His brother William Wilkinson invented the cupola in 1790.

Sheffield's Lighter Trades

Col. F. A. Neill, who was recently installed as the 304th Master Cutler in Sheffield, questioned in his speech whether anyone present would not have asserted as recently as 1933 that the steel melting, cogging and rolling capacity in the city was in excess of likely requirements, even taking into account a return to normal trade prosperity. Sheffield relied greatly for her prosperity on the welfare of the heavy steel industry, but he would like, also, to refer to the lighter trades, of which he had more personal knowledge and which were responsible for the employment of nearly as many workpeople as the heavy industries. Generally speaking, they were more dependent for their success on their export trade, so vital to this country, and if this exacting and risky trade was to be maintained, the cost of raw materials, supplied largely by the heavy steel industry, must be kept as low as possible, consistent with a reasonable margin of profit. The Master Cutler suggested that the smaller firms, in these days of prosperity, should put back a substantial portion of profit into the business, and to reserve, and that adequate depreciation should be made so that plant and equipment might be modernised and kept up to date.

The Falkirk Foundryman

The Falkirk Section of the Institute of British Foundrymen held its annual smoking concert in the Argyll Restaurant, Falkirk, on October 15. Mr. Norman Erskine, retiring chairman, presided at the outset, and among those present was Mr. E. J. Ross, President of the Scottish Branch. Apologies for absence were received from Mr. H. Winterton, Milngavie, immediate Past-President of the Institute, and from Mr. J. Bell, Glasgow, Scottish Branch Secretary.

Mr. Erskine said their new chairman, Mr. H. Cowan, had been in Falkirk for 16 years. When he came he faced a difficult task, and succeeded splendidly. He was now regarded as one of the premier foundry technicians and metallurgists in the country.

Mr. Cowan, in reply, said his work took him to foundries in Scotland, England and Wales, and the more he saw of the industry the more he marvelled at the skill and ability of the Falkirk foundrymen. It was easy to recognise immediately a Scottish foundryman by the way the work was done, and it was always possible to pick a Falkirk man from the rest. To his knowledge there were only two foundries in Great Britain that had no Scotsmen on the floor. He had found that in the other foundries there was at least one Falkirk man and quite a number of other Scotsmen. The reason was that the iron-founding industry was ingrained in the Falkirk men, just as steelmaking was inborn in the men of Sheffield, and marine engineering in the men of Glasgow. It was for that reason that he was so proud of being elected chairman of the Falkirk Section.

Mr. Ross and Mr. J. M. Primrose also delivered short addresses. Members of the company entertained the gathering with songs, anecdotes and readings. Community singing was also a part of the proceedings.

Book Review

Training in Foremanship and Management. 2nd Edition. By J. J. Gillespie. Published by Sir Isaac Pitman & Sons, Limited, Parker Street, Kingsway, London. Price 7s. 6d. net.

We have sometimes postulated that if a student was thoroughly cognisant of what exactly constituted the thought output of the man who matters, he would never acquire the mental training so essential as a background to later successful management. This book, whilst not disclosing the whole of the mental make-up of the modern manager, gives some insight into it, and the reviewer feels that whilst its contents would have a beneficial effect on some students—and the book is specifically addressed to this class—it is reasonably certain that on others the reverse would be the case. It is perhaps best to concentrate the attention of the student on the acquiring of technical knowledge and related culture, and to leave such subjects as are covered in the first part of the book—social, psychological, economic and personal aspects of management and histories of industrial and trade union development—until he is a journeyman or graduate.

Part II of the book is, on the other hand, eminently suited to put in the hands of a student of either tender or advanced years, for herein, in thirteen chapters, the general structure of a works organisation is detailed. An explanatory note on Chapter XVII, dealing with time and motion studies and rate fixing, might reasonably have been added to the effect that such work is for the sympathetic specialist to undertake, as any mistakes are liable to lead to endless labour troubles. The book has already shown its worth by the fact that a second edition has been demanded. The reviewer not having handled the first one is unable to comment on any changes.

V. C. F.

The Week's News in Brief

Trade Talk

THE INTERNATIONAL MEEHANITE METAL COMPANY, LIMITED, has changed its address to 66, Victoria Street, London, S.W.1. The new telephone number is Victoria 8810.

DR. C. H. DESCH, F.R.S., is to lecture to the Chemical Engineering Group of the Society of Chemical Industry on the subject of "The Alloys of the Light Metals" at a meeting to be held in the Royal Technical College, Glasgow, on November 5.

R. & W. HAWTHORN, LESLIE & COMPANY, LIMITED, Newcastle-upon-Tyne, have received an order from the Union Steamship Company of New Zealand for a 6,000-ton cargo vessel, the engines for which are to be supplied by the North-Eastern Marine Engineering Company, Limited, Wallsend.

THE FORD MOTOR-CAR SHOW, now being held at the Albert Hall, includes an exhibit housed in a separate room designed to show the potentialities of their pig-iron. To this end they have drawn upon typical castings made by their own foundry and the foundries of their customers. Around the walls are some particularly fine plaques showing the development of the foundry industry. These are quite suitable to use as patterns, and we hope that next year they will be exhibited in this form.

REPRESENTATIVES FROM twelve European countries are to meet at the annual sales convention of Henry Wiggin & Company, Limited, the well-known producers of nickel alloys, of Birmingham, to be held from October 25 to 29. A full programme has been arranged for the company's visitors, and they will inspect not only the Wiggin company's plants at Birmingham, but also the Clydach refinery of the Mond Nickel Company, Limited. A series of discussions will take place on the applications of nickel, Monel and Inconel, the range and scope of the Wiggin chemical salts, the development of depolarised and other anodes, also on the work of the Bureau of Information on Nickel. Social activities are to include a visit to Stratford-on-Avon and a dinner at Swansea.

Obituary

MR. M. W. MILLS, a director of James Mills & Company (Engineers), Limited, Heywood, Lancs, has died, aged 69.

MR. JAMES BRADBURY, who was for nearly forty years employed at the foundry of J. & E. Arnfield, Limited, New Mills, near Stockport, died recently.

Mechanical Properties of Some Tin Bronzes

(*Concluded from page* 322.)

The superior values of elongation for these bronzes and their malleability allow cold-working to be continued to a considerable extent and very interesting mechanical properties are obtained in this way.

Figs. 10 to 13 give the mechanical properties as a function of the degree of cold-working for bronzes containing 6.5, 10, 12 and 14 per cent. of tin. They were determined on bars 42 mm. in diameter, the metal being in the as-drawn condition. With increasing tin content, cold-working hardens the metal to an increased extent and bars of bronze containing 14 per cent. of tin having a tensile strength of more than 100 kg./mm.^{2} with an elongation of 3 to 4 per cent. can be obtained in this way.

From the viewpoint of structure, all these bronzes containing up to 14 per cent. of tin consist entirely of a solid solution of tin in copper as shown in the photomicrographs (Figs. 3 to 5). With 14.5 per cent. of tin, however, the δ constituent begins to appear (see Fig. 6).

The corrosion and frictional resistance of these tin-bronzes are well known and have been frequently verified. Moreover, with their mechanical properties improved in this way, these alloys can be classed among the best existing at present.—Reprinted by courtesy of the International Tin Research and Development Council.

Personal

LORD NUFFIELD is to receive the freedom of the City of Cardiff.

MR. C. R. D. TUCKEY has joined the sales staff of British Timken, Limited, Birmingham.

MR. W. C. LEMPRIERE has retired from the board of J. & E. Hall, Limited, engineers and ironfounders, of Dartford.

MR. EDWARD WHALLEY, who for nearly 30 years has been employed in the foundry of Naylor Bros., Limited, Golborne, Lancashire, has retired at the age of 71 years.

MR. OLIVER JAMES LOWE has completed fifty years' service with John Roby, Limited, iron and non-ferrous founders, of Rainhill, Liverpool. The directors have presented him with a cheque and a silver salver.

MR. W. J. GIBBS, by arrangement with R. A. Lister & Company, Limited, Dursley, has joined the board of A.C.E. Machinery, Limited, Brixton. Mr. Gibbs has for the past seven years been on the executive staff of Lister's.

MR. E. J. EVANS, of Guest, Keen, Williams, Limited, Calcutta, will take up residence in Birmingham for three months from November 1, and will be attached to the service department of British Timken, Limited, manufacturers of ball and roller bearings.

MR. CHARLES E. SIDDALL, chairman of the Sheffield Forge & Rolling Mills Company, Limited, was entertained at the Royal Victoria Station Hotel, Sheffield, last week, by the directors of Darwins, Limited, from whose board he has retired after many years' service.

MR. H. H. HENBREY has resigned from the board of A.R.M., Limited of the Redheugh Iron and Steel Works, although retaining a financial interest therein, in order to become a director of the British Kanteck Drill Company, Limited, of London, and Kanteck Metals, Limited.

MR. D. P. C. NEAVE, who has been general manager and secretary of the Copper Development Association since its inception in 1933, is resigning at the end of the present year. Mr. G. W. Preston, the Association's electrical engineer, has been appointed to become general manager, and Dr. S. Baker, now assistant secretary, will become secretary.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Joshua Bigwood & Son, Limited, Wolverhampton.—Capital, £100. Ironfounders, mechanical engineers, etc.

T. Carter & Sons (Cardiff), Limited, 9, Mill Lane, Cardiff.—Capital, £500. Ironfounders, engineers, etc. Director: W. J. Gwyther.

Middleton & Johnston, Limited, 17, Ashbourne Road, Birmingham.—Capital, £300. Tool makers, brass founders, etc. Director: A. J. A. Middleton.

H. Hilt (Engineers), Limited, 247, Argyll Avenue Trading Estate, Slough.—Capital, £2,000. Ironfounders and engineers, etc. Directors: E. H. H. Hilt and R. M. Meyer.

Barr & Company (Brassfounders), Limited, Cartsburn Foundry, Orchard Street, Greenock.—Capital, £6,000. Directors:—T. C. Riddell, I. M'Callum Lang, and J. V. Fulton.

Cleaning Castings by Hydrofluoric Acid

It is stated that some foundries for special jobs pickle their castings in hydrofluoric acid. We do not believe the practice is extensively used, but one of our readers is anxious to have a working formula. Hydrofluoric acid is on the market at a 60 per cent. strength, and there is some talk of dilution and addition of sulphuric acid. As these acids are dangerous to play with, the experience of any of our readers would be appreciated.

Company Reports

Skefko Ball Bearing Company, Limited.—Interim dividend of 10 per cent., free of tax.

Callender's Cable & Construction Company, Limited.—Interim ordinary dividend of 5 per cent.

Round Oak Steelworks, Limited.—Final dividend of 3½ per cent. on the ordinary shares, making 6 per cent. for the year.

Brown, Bayley's Steelworks, Limited.—Year's dividend to July 31, 1937, on the 5 per cent. cumulative preference shares.

Ferranti, Limited.—Net profit for year ended June 30, £64,923; brought in, £54,472; preference dividend, £35,000; dividend of 6 per cent. on the ordinary stock, £18,000; to general reserve, £10,000; carried forward, £56,395. Meeting, October 20.

Cochran & Company, Annan, Limited.—Profit for year ended June 30 of £21,812, after crediting a surplus of £5,015 on realisation of investment and £5,800 from stock revaluation account; debit balance brought in, £185; taxation, £4,332; final dividend of 5 per cent., making 7½ per cent. for the year; to reserve, £8,000; carried forward, £1,810.

Applications for Trade Marks

The following list of applications to register trade marks has been taken from the "Trade Marks Journal":—

"C.B.S."—Castings. C. & B. Smith, Limited, Stewart Street, Wolverhampton.

"PRESMET."—Electrodes and electric welding plant. British Insulated Cables, Limited, Prescot, Lancashire.

"CRALFER."—A cast-iron-aluminium alloy. British & Dominions Feralloy, Limited, 40, Grosvenor Gardens, London, S.W.1.

"BRIMOL."—Ferrous castings. British Piston Ring Company, Limited, Holbrook Lane, Coventry.

"WALLRAMIT."—Base metals and alloys. Tools & Drawing Dies, Limited, Shropshire House, 12-20, Pancras Street, London, W.C.1.

"PALLACAST."—Cast metal. Baker Platinum, Limited, 52, High Holborn, London, W.C.1.

"BICOP."—Copper and copper alloys. British Insulated Cables, Limited, Prescot, Lancs.

Application to the Cutlers' Company, Sheffield.

"SILVER FOX" (AND DEVICE).—Naval architectural contrivances and naval equipment not included in other classes. Samuel Fox & Company, Limited, Stocksbridge Works, Stocksbridge, Sheffield.

Catalogue Received

Vacuum Gauges. A number of newly-designed measuring instruments are described and illustrated in an eight-page catalogue issued by W. Edwards & Company, Vaughan Road, Loughborough Junction, London, S.E.5. Included in the list are manometers and many types of rubberless mercury gauges.

Forthcoming Events

Institute of British Foundrymen

OCTOBER 22 AND 23.

Birmingham, Coventry and West Midlands Branch, and London Branch:—Joint meeting in Birmingham. Friday: Works visit and Supper. Saturday: Works visit; Papers, "Can the Metallurgist Run the Foundry?" by C. H. Kain, and "Synthetic Sand *v.* Natural Sand," by A. Tipper, B.Sc.

OCTOBER 23.

East Midlands Branch:—Paper, "Patternmaking for Production Moulding," by S. A. Horton, at the Loughborough College, Loughborough, at 6 p.m.

OCTOBER 29.

Sheffield Branch and Lincolnshire Section:—Joint visit to works of Ruston & Hornsby, Limited.

OCTOBER 30.

Newcastle and District Branch:—Paper, "Treatment of Iron Castings after Casting," by H. Herdman, at Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6.15 p.m.

The Institute of Vitreous Enamellers

OCTOBER 28.

Scottish Section:—Paper, "Some Notes on Specks in Fired Enamels," by J. G. Roberts, at Royal Technical College Society's Room, Glasgow, at 7.30 p.m.

TOR ROCK SAND
for the
FOUNDRY

It is now possible to obtain from a deposit in the Midlands, *a moulding sand possessing all the excellent characteristics of the Scottish Rock sands.* This sand we have called Tor Rock Sand. It is well bonded, coarse in grain, and highly permeable.

Tor Rock Sand is most suitable for withstanding the severe conditions of high casting temperatures in iron foundries, particularly where special alloys are melted.

Please write for full particulars and sample.

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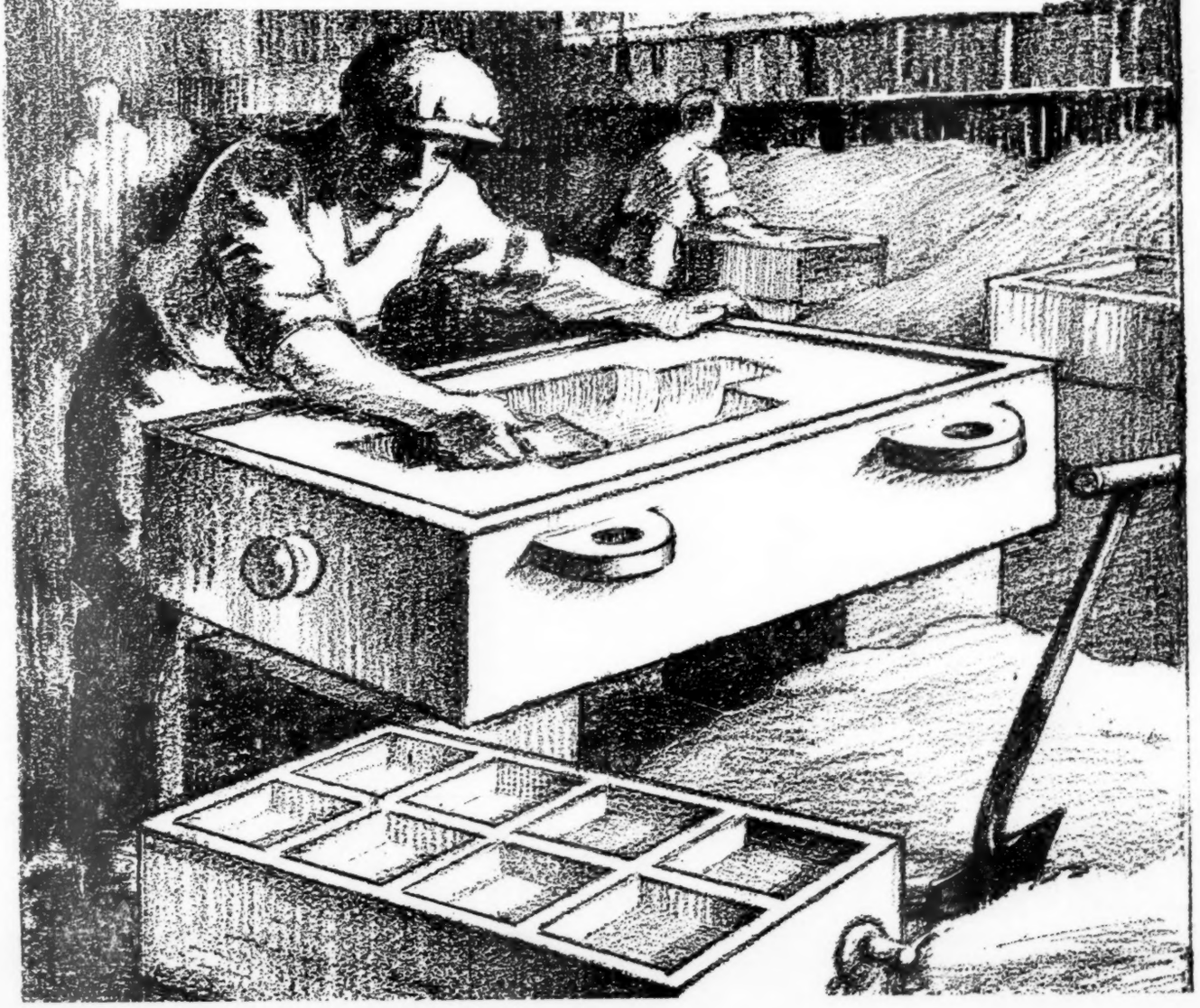
GENEFAX HOUSE, SHEFFIELD.

Telephone: 31113 (6 lines). Telegrams: "Genefax, Sheffield."



Raw Material Markets

Little new business will be transacted until next year's prices are announced. Current quotations cease to be valid on December 31, and at these rates producers are fully booked over the remainder of the year. Consumers are anxious to place further orders for the first few months of 1938 and some users would be willing to negotiate over the whole year. Imports of pig-iron and scrap from overseas remain on a good scale and help greatly to ease the position at the consuming plants.

Pig-Iron

MIDDLESBROUGH.—Full outputs of pig-iron are going immediately into consumption, but, even so, delivery arrears remain heavy. It is likely that a fair amount of business will be negotiated when the new prices are published, but, meanwhile, trade is in abeyance. Most producers will have a number of orders still to be carried out after the turn of the year. Prices are nominal at 101s. for Cleveland G.M.B. delivered in the Middlesbrough area, 104s. in Falkirk and 107s. in Glasgow. It is almost certain that increases of several shillings per ton will be made for next year's trade. Deliveries of Cleveland foundry iron continue to be strictly rationed.

Ordinary grades of hematite are generally sufficient fully to meet the demands of consumers, but low-phosphorus iron is not so plentiful. Consumers in the Midlands and in Sheffield are calling for large tonnages and no surplus is available for export business. East Coast mixed numbers are nominal at 122s. 6d. per ton. An additional 5s. 6d. is charged for deliveries to Sheffield, while 11s. extra is invoiced to Birmingham. Prices are subject to the loyalty rebate of 5s. per ton.

LANCASHIRE.—Insistent demands for deliveries continue to be forthcoming, but new business is quiet, as makers are fully contracted up to the end of the year. Activity at the light-castings foundries remains slightly below normal. While deliveries have improved and are now quite satisfactory, some makers still have considerable arrears to be made up. For delivery to users in the Lancashire price zone, offers of Derbyshire and Staffordshire No. 3 foundry iron are on the basis of 109s., with Northamptonshire at 107s. 6d., and Derbyshire forge iron at 104s. to 106s., according to the class of user. Supplies of hematite are easier to procure, East Coast material, especially, being more plentiful. Scottish foundry iron at 140s. to 142s. 6d. per ton remains very scarce and is firm. A moderate tonnage of United States pig-iron at about 150s. delivered has been booked.

MIDLANDS.—Although it is not usually possible to accumulate stocks of any size, consumers are kept supplied with pig-iron, and conditions are much more satisfactory. In some cases, users are able to secure small supplementary tonnages in addition to their contract commitments. Prices are unchanged, the controlled levels being 103s. 6d. for Northants No. 3 and 106s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, delivered Birmingham and Black Country stations. Consumers of special-grade irons are active, and the demand for these qualities is fully maintained. Heavy engineers and machine-tool makers, particularly, are expected to have increasing requirements over the next few months. Prices of special iron vary from £6 5s. to £6 15s. delivered to Birmingham and district, while refined iron is controlled at £8 2s. 6d. per ton. Scottish iron at £7 per ton is not easily obtained. Hematite makers are well sold, and there is difficulty in complying with contract commitments. Prices are fixed up to the end of the year as follow:—£6 13s. 6d. for East Coast No. 3 and £6 14s. 6d. for West Coast mixed numbers, delivered local stations, with 1s. 6d. per ton more if delivered into works.

SCOTLAND.—As a result of substantial imports, the pig-iron situation is much easier in this area. No. 3 foundry is quoted at 118s. f.o.t. furnaces, with No. 1 at 120s. 6d. No Cleveland iron is offered and the quotations are nominal at 104s. f.o.t. Falkirk and 107s. f.o.t. Glasgow. In some cases steelworks are now able to place pig-iron into stock, but, generally, deliveries only meet current needs. Hematite and basic are well taken up. There are no price changes at 123s. for hematite mixed numbers, 107s. 6d. for Scottish basic, and 100s. for English and Indian basic, all less 5s. rebate, delivered steelworks.

Coke

Following the recent increase in the price of Durham foundry coke, a fair amount of business has gone through. Consumers can now book orders up to the end of 1938 if they so desire, but, generally speaking, ironfoundries have purchased their winter needs only. For delivery to Birmingham and Black Country stations, best Durham coke is quoted at 55s. 9d., with Welsh coke at from 55s. to 65s. per ton, according to quality.

Steel

Although conditions of great industrial activity continue to rule in the steel trade, new business is restricted, partly through the difficulty of placing orders for near delivery and partly owing to the uncertainty regarding prices which will rule after the end of the year, says the official report of the London Iron and Steel Exchange. Although supplies are on a much better scale than a few weeks ago, stringent conditions continue to rule in several departments. Conditions in the semi-finished steel department remain rather tight, and, although production in this country is on a heavy scale, and deliveries of foreign steel are arriving in larger quantities, there is still barely sufficient to meet users' requirements. In the finished steel department, stringent conditions rule and consumers continue to press for deliveries. The position, however, appears to be improving, although the export demand remains quiet.

Scrap

It is announced that the steelworks have agreed to raise delivered scrap prices by sums varying from 6d. to 1s., according to district. This follows the decision of the Railway Rates Tribunal to advance railway rates. Particulars of the new delivered charges are as follow:—East Wales, 9d. extra; West Wales, 1s.; all other districts, 6d., except that for Shotton an addition of 9d. instead of 6d. can be made on No. 8 specification scrap (old light wrought iron and steel) only, consigned from London and stations south of Shotton. For scrap delivered coastwise an addition of 1s. can be made.

Supplies of cast-iron scrap are more readily obtained, but steelworks continue to take up all available tonnages of home-produced material. Foreign scrap, at prices considerably higher than home quotations, is being used in large tonnages, but every effort is made to procure home scrap.

Metals

The erratic conditions on Wall Street continue to influence the commodity markets in this country. The metal markets are nervous, and prices have moved to still lower levels.

Copper.—Buying has continued to be quiet, and consumers have displayed little interest in the metal, as contracts provide adequately for current requirements, which are still substantial. In the United States, the recent price fluctuations have rather upset the market, and business is confined to small tonnages. Figures compiled by the Copper Institute reveal that world stocks of refined copper increased during September by 13,427 tons to 344,738 tons, while American stocks were 18,137 tons higher at 144,321 tons, which was considerably less than had been anticipated. The apparent world consumption amounted to 184,000 tons, of which American consumption accounted for 66,000 tons. The world output by mines and smelters totalled 197,000 tons, America's output being 84,000 tons. The world production of refined copper reached 197,000 tons, with American production totalling 91,000 tons.

Metal Exchange quotations were as follow:—

Cash.—Thursday, £45 7s. 6d. to £45 10s.; Friday, £45 8s. 9d. to £45 10s.; Monday, £45 7s. 6d. to £45 10s.; Tuesday, £42 10s. to £42 15s.; Wednesday, £43 7s. 6d. to £43 10s.

Three Months.—Thursday, £45 12s. 6d. to £45 15s.; Friday, £45 13s. 9d. to £45 15s.; Monday, £45 13s. 9d. to £45 16s. 3d.; Tuesday, £42 15s. to £43; Wednesday, £43 12s. 6d. to £43 13s. 9d.

Tin.—This market continues to be very uncertain, and while sentiment is so nervous, buyers prefer to stand aloof. United States buying is quiet, while Japanese demands are negligible. American purchasers generally carry fairly substantial stocks. World tin stocks declined by 3,130 tons to 19,754 tons in September. The fall is chiefly attributed to stock-taking activities by the Straits Trading Company, and it is likely that an increase will take place during the current month.

Official quotations were as follow:—

Cash.—Thursday, £226 10s. to £226 15s.; Friday, £222 10s. to £222 15s.; Monday, £219 15s. to £220; Tuesday, £206 10s. to £206 15s.; Wednesday, £210 10s. to £211.

Three Months.—Thursday, £225 5s. to £225 10s.; Friday, £221 15s. to £222; Monday, £219 to £219 5s.; Tuesday, £206 10s. to £206 15s.; Wednesday, £210 to £211.

Spelter.—Although the easy tone persists, some good buying has gone through. The weekly Trade report issued by Rudolf Wolff & Company states that on the London market, selling pressure has been largely reduced, and, at the same time, the market has enjoyed a certain measure of influential support, buyers no doubt being attracted by the comparatively low prices prevailing.

Daily market prices:—

Ordinaty.—Thursday, £17 17s. 6d.; Friday, £17 13s. 9d.; Monday, £17 11s. 3d.; Tuesday, £16 13s. 9d.; Wednesday, £16 13s. 9d.

Lead.—Active conditions still prevail at the lead-consuming plants in this country and the outlook as far as consumption is concerned is quite satisfactory. The market has been rather steadier, but it is expected that prices will continue to fluctuate according to quotations in other markets. The United States market is dull. There was a small increase in the value of building plans approved by local authorities in September, due mainly to a substantial increase in the Scottish total and smaller rises in the Northern, South Midland, Eastern and South-Western counties districts. The total at £9,093,800 compares with £9,018,300 for September, 1936. Housing, the largest item, continues to decline, while there was also a falling off in factory plans.

Day-to-day quotations:—

Soft Foreign (Prompt).—Thursday, £18; Friday, £18; Monday, £18 2s. 6d.; Tuesday, £17 10s.; Wednesday, £17 13s. 9d.

Scrap.—Business continues on a hand-to-mouth basis and only small tonnages are changing hands. With the exception of aluminium prices, which are unchanged, values have declined.

Approximate selling prices for old metal:—New aluminium cuttings, £82; rolled, £67; cast, £42; foil, £94 to £98. Copper, £42 to £45; braziery, £39. Brass (clean), £27 to £30. Zinc, £13. Lead, £17. Gunmetal, £45 to £46.

BRITISH ALUMINIUM
The BRITISH ALUMINIUM CO. Ltd., ADELAIDE HOUSE, KING WILLIAM ST., LONDON, E.C.4. PHONE: MANSION HOUSE 5561 AND 8074. TELEGRAMS: CRYOLITE, BILGATE, LONDON.

LIGHT CASTINGS

We are in a position to undertake the manufacture of light cast iron parts in large quantities.

The supply of complete components.

Machining work—Planing, Milling. Centre and Capstan Lathe Work, etc.

PRINCE-SMITH & STELLS,
LIMITED,
KEIGHLEY.

SPECIAL "G" QUALITY CUPOLA BRICKS

Works: HOMER HILL, BRETTELL LANE, TINTAM ABBEY, CROWN, DELPH.

Mines: RAVENSITCH, HOMER HILL, CROWN, DELPH.

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LTD.,
STOURBRIDGE
ESTABLISHED
1860

Telephone: 7201 Brierley Hill (3 lines).

Telegrams: "Firebrick, Stourbridge."

Blast Furnace Linings and Stove Bricks

Special "F.R.D." Coke Oven Bricks (High Silica Quality)

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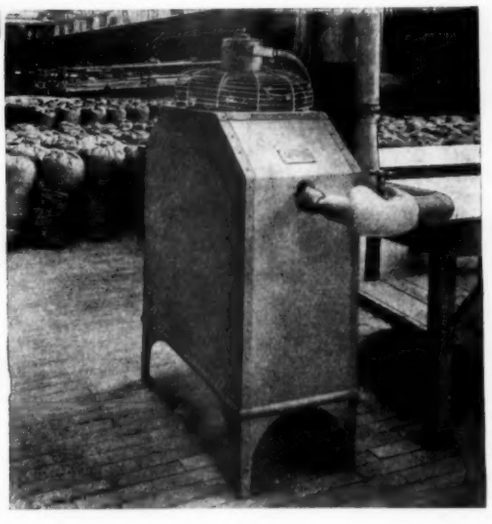
TRADE SIROCCO MARK

Unit System of Air Heating and Circulation

SPECIFY "SIROCCO" UNIT AIR HEATERS AND CIRCULATORS



"Sirocco" L.P. Unit Air Heater and Circulator with electrically driven Fan. Installed in the Packing Department of a Soap Making Factory.

● **Heat Source:** Steam (any pressure up to 150 lbs. per sq. in.) Solid or Liquid Fuel.

● **Fan Drive:** Steam Turbine, Electric Motor, or Belt.

● Combined Heating and Ventilating Units ideal for Factory Warming and Ventilation.

● No Air Ducts required—No obstruction to existing Plant—No irregular Heating—Easy Temperature Control—Installation extended as required.

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Ref. No. S.F.252

DAVIDSON & CO., LIMITED
Sirocco Engineering Works, Belfast
LONDON MANCHESTER NEWCASTLE BIRMINGHAM GLASGOW CARDIFF DUBLIN

RAW MATERIALS—PRICE LIST

(Wednesday, October 20, 1937)

COPPER

	£	s.	d.
Standard cash	43	7	6
Three months	43	12	6
Electrolytic	48	0	0
Tough	48	2	6
Best selected	48	12	6
Sheets	51	17	6
India	59	10	0
Wire bars	49	17	6
Ingot bars	49	17	6
H.C. Wire rods	57	11	3
Off. av. cash, Sept.	53	0	$7\frac{37}{44}$
Do., 3 mths., Sept.	53	2	$2\frac{1}{4}$
Do., Sttlmnt., Sept.	53	1	$0\frac{1}{11}$
Do., Electro, Sept.	59	12	$7\frac{5}{11}$
Do., B.S., Sept.	60	0	$7\frac{1}{2}$
Do., wire bars, Sept.	60	5	$10\frac{10}{11}$
Solid drawn tubes			13¼d.
Brazed tubes			13¼d.
Wire			9d.

BRASS

Solid drawn tubes	11¾d.
Brazed tubes	13¾d.
Rods, drawn	9¾d.
Rods, extd. or rlld.	7¼d.
Sheets to 10 w.g.	9¼d.
Wire	9d.
Rolled metal	8¾d.
Yellow metal rods	7¼d.

TIN

	£	s.	d.
Standard cash	210	10	0
Three months	210	10	0
English	210	10	0
Bars	212	10	0
Straits	214	10	0
Eastern	222	15	0
Banca (nom.)			—
Off. av. cash, Sept.	259	2	$2\frac{13}{32}$
Do., 3 mths., Sept.	258	1	$9\frac{27}{32}$
Do., Sttlmt., Sept.	259	1	$8\frac{5}{11}$

SPELTER

	£	s.	d.
Ordinary	16	13	9
Remelted	15	5	0
Hard	14	5	0
Electro, 99.9	20	7	6
English	17	15	0
India	15	0	0
Zinc dust	24	10	0
Zinc ashes	6	15	0
Off. aver., Sept.	21	10	$1\frac{47}{88}$
Aver., spot, Sept.	21	8	$1\frac{1}{2}$

LEAD

	£	s.	d.
Soft foreign, ppt.	17	13	9
Empire (nom.)	18	7	6
English	19	15	0
Off. aver., Sept.	21	0	$4\frac{1}{11}$
Aver. spot, Sept.	20	19	$9\frac{27}{44}$

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	30	10	0	to 31	0	0
Do., V.M. ex-whse.	30	10	0	to 31	0	0
Rods				27	0	0

ANTIMONY

English	92	10	0	to 93	10	0
Chinese, ex-whse. (nom.)				83	0	0
Crude, c.i.f.				47	0	0

QUICKSILVER

Quicksilver	13	5	3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	14 10 0
45/50%	12 0 0
75%	17 0 0
Ferro-vanadium	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/9 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£21 to £22
Ferro-tungsten—	
80/85%	9/3 lb.
Tungsten metal powder—	
98/99%	9/6 lb.
Ferro-chrome—	
2/4% car.	34 15 0
4/6% car.	24 5 0
6/8% car.	24 0 0
8/10% car.	24 0 0
Ferro-chrome—	
Max. 2% car.	36 0 0
Max. 1% car.	38 5 0
Max. 0.5% car.	41 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£180 to £185
"F" nickel shot	£165 0 0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£18 15 0 to 19 5 0
76/80% packed	£19 15 0 to 20 5 0
76/80% export	£22 0 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 10d.
Finished bars, 18% tungsten	5s. 0d.

Per lb. d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales (West)—						
Heavy steel, best	3	8	6 to	3	11	0
Mixed iron and steel	3	6	0 to	3	8	6
Heavy cast iron	3	8	6 to	3	11	0
Good machinery				3	17	6
Cleveland—						
Heavy steel, best	3	7	0 to	3	9	6
Steel turnings				2	15	0
Heavy cast iron				4	5	0
Heavy machinery				4	10	0
Midlands—						
Short heavy steel	3	17	6 to	4	0	0
Light cast-iron scrap	3	2	6 to	3	5	0
Heavy wrought iron	4	0	0 to	4	5	0
Steel turnings	2	5	0 to	2	8	0
Scotland—						
Heavy steel, best	3	5	0 to	3	7	6
Ordinary cast iron	4	7	6 to	4	10	0
Cast-iron borings	2	0	0 to	2	2	6
Wrot-iron piling				4	17	6
Heavy machinery	4	16	0 to	4	16	3

London—Merchants' buying prices, delivered yard.

Copper (clean)	38	0	0
Brass	26	10	0
Lead (less usual draft)	15	0	0
Tea lead	12	0	0
Zinc	11	0	0
New aluminium cuttings	71	0	0
Braziery copper	34	0	0
Gunmetal	40	0	0
Hollow pewter	160	0	0
Shaped black pewter	120	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	103/6
,, No. 3	101/-
,, No. 4	100/-
Forge No. 4	100/-
Hematite No. 1	123/-*
Hematite M/Nos.	122/6*
N.W. Coast—	
Hem. M/Nos. d/d Glas.	123/-*
,, d/d Birm.	134/6*
Malleable iron d/d Birm.	160/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	103/-
,, No. 3 fdry.	106/-
Northants forge	100/6
,, fdry. No. 3	103/6
,, fdry. No. 1	106/6
Derbyshire forge	103/-
,, fdry. No. 3	106/-
,, fdry. No. 1	109/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
,, No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	107/-
,, ,, Falkirk	104/-
Scottish hem. M/Nos. d/d	123/-*
Sheffield (d/d district)—	
Derby forge	100/6
,, fdry. No. 3	103/6
Lincs forge	100/6
,, fdry. No. 3	103/6
W.C. hematite	128/6*
Lancashire (d/d eq. Man.)—	
Derby fdry, No. 3	109/-
Staffs fdry. No. 3	109/-
Northants fdry. No. 3	107/6
Cleveland fdry. No. 3	109/6
Glengarnock, No. 3	142/6
Clyde, No. 3	142/6
Monkland, No. 3	142/6
Summerlee, No. 3	142/6
Eglinton, No. 3	142/6
Gartsherrie, No. 3	142/6
Shotts, No. 3	142/6

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	13	5	0 to	13	15	0
Nut and bolt iron	11	12	6 to	12	2	6
Hoops				14	2	6
Marked bars (Staffs) f.o.t.				15	15	0
Gas strip				14	2	6
Bolts and nuts, ¾ in. × 4 in.				17	10	0 and up.
Steel—						
Plates, ship, etc.	11	8	0 to	11	10	6
Boiler plts.	11	18	0 to	12	0	6
Chequer plts.				13	0	6
Angles				11	0	6
Tees				12	0	6
Joists				11	0	6
Rounds and squares, 3 in. to 5½ in.				12	0	6
Rounds under 3 in. to ⅜ in. (Untested)				11	9	0
Flats—8 in. wide and over				11	5	6
,, under 8 in. and over 5 in.				11	10	6
Rails, heavy				10	2	6
Fishplates				14	2	6
Hoops (Staffs)				12	4	0
Black sheets, 24g. (4-t. lots)				15	15	0
Galv. cor. shts. (,,)				19	10	0
Galv. flat shts. (,,)				20	0	0
Galv. fencing wire, 8g. plain				20	5	0
Billets, soft, 100-ton lots				7	17	6
Sheet bars				7	15	0
Tin bars				7	15	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	12d.
Sheet to 10 w.g.	12½d.
Wire	14d.
Rods	14½d.
Tubes	19d.
Castings	16d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
to 10g.	1/6½ to 2/1½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/5½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	42/6
,, furnace	37/6
Durham foundry	38/6
,, furnace	37/6
Scottish foundry	42/6
,, furnace	40/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14	per box	25/- to 26/-
,,	28×20	,,	50/- to 52/-
,,	20×10	,,	36/6 to 36/9
,,	18¾×14	,,	26/3 to 26/6
C.W.	20×14	,,	22/- to 23/-
,,	28×20	,,	45/- to 46/-
,,	20×10	,,	32/- to 32/6
,,	18¾×14	,,	23/- to 23/6

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£12	0	0	to £13	0	0
Bars-hammered, basis	£20	0	0	to £22	0	0
Bars and nail-rods, rolled, basis	£19	0	0	to £20	0	0
Blooms	£18	0	0	to £19	0	0
Keg steel	£30	0	0	to £35	0	0
Faggot steel	£20	0	0	to £25	0	0
Bars and rods dead soft st'l	£19	0	0	to £20	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
Oct.	14 ..	45 7 6	dec. 5/-
„	15 ..	45 8 9	inc. 1/3
„	18 ..	45 7 6	dec. 1/3
„	19 ..	42 10 0	„ 57/6
„	20 ..	43 7 6	inc. 17/6

Electrolytic Copper

		£ s. d.	
Oct.	14 ..	51 10 0	No change
„	15 ..	50 10 0	dec. 20/-
„	18 ..	50 10 0	No change
„	19 ..	47 0 0	dec. 70/-
„	20 ..	48 0 0	inc. 20/-

Standard Tin (cash)

		£ s. d.	
Oct.	14 ..	226 10 0	inc. 50/-
„	15 ..	222 10 0	dec. 80/-
„	18 ..	219 15 0	„ 55/-
„	19 ..	206 10 0	„ 265/-
„	20 ..	210 10 0	inc. 80/-

Tin (English ingots)

		£ s. d.	
Oct.	14 ..	226 10 0	inc. 50/-
„	15 ..	222 10 0	dec. 80/-
„	18 ..	219 15 0	„ 55/-
„	19 ..	206 10 0	„ 265/-
„	20 ..	210 10 0	inc. 80/-

Spelter (ordinary)

		£ s. d.	
Oct.	14 ..	17 17 6	inc. 2/6
„	15 ..	17 13 9	dec. 3/9
„	18 ..	17 11 3	„ 2/6
„	19 ..	16 13 9	„ 17/6
„	20 ..	16 13 9	No change

Spelter (Electro, 99.9 per cent.)

		£ s. d.	
Oct.	14 ..	21 10 0	inc. 1/3
„	15 ..	21 6 3	dec. 3/9
„	18 ..	21 5 0	„ 1/3
„	19 ..	20 7 6	„ 17/6
„	20 ..	20 7 6	No change

Lead (soft foreign, prompt)

		£ s. d.	
Oct.	14 ..	18 0 0	No change
„	15 ..	18 0 0	„ „
„	18 ..	18 2 6	inc. 2/6
„	19 ..	17 10 0	dec. 12/6
„	20 ..	17 13 9	inc. 3/9

Lead (English)

		£ s. d.	
Oct.	14 ..	20 0 0	No change
„	15 ..	20 0 0	„ „
„	18 ..	20 5 0	inc. 5/-
„	19 ..	19 10 0	dec. 15/-
„	20 ..	19 15 0	inc. 5/-

Imports and Exports of Pig-iron, Castings, etc., in September and the Nine Months 1937, compared with September and the Nine Months 1936

	September.		Nine months.		September.		Nine months.	
	1936.	1937.	1936.	1937.	1936.	1937.	1936.	1937.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Imports.								
Pig-iron—from British India	22,107	16,864	94,520	147,632	70,078	86,252	297,043	583,152
„ „ Other British Countries	—	6,210	—	42,666	—	30,504	—	233,942
„ „ Foreign Countries	37,330	57,327	78,397	248,473	106,735	366,267	269,910	1,515,916
Total	59,437	80,401	172,917	438,771	176,813	483,023	566,953	2,333,010
Castings and forgings	272	366	5,296	2,182	11,874	13,571	185,211	70,940
Cast pipes and fittings	154	392	1,156	1,289	3,800	8,634	38,280	31,893
Stoves, grates, etc.	40	49	588	709	4,401	5,174	55,957	67,526
Baths	865	652	5,834	7,040	20,176	16,984	142,569	172,992
Hollow-ware, all kinds	407	389	2,732	2,979	18,279	25,248	146,163	178,160
Exports.								
Pig-iron, forge and foundry	5,245	8,205	44,568	72,658	20,454	46,531	169,310	385,792
„ acid	3,768	6,544	29,482	48,361	13,946	40,392	106,971	265,324
„ basic	—	—	148	668	—	—	793	4,591
Total	9,013	14,749	74,198	121,687	34,400	86,923	277,074	655,707
Castings and forgings	266	210	3,050	2,395	10,337	7,970	115,445	91,609
Cast pipes and fittings, up to 6 in. diameter	5,568	5,122	42,642	45,316	61,947	62,022	476,261	508,614
„ „ „ over 6 in. „	2,763	4,234	29,030	37,108	21,796	34,246	237,199	293,106
Stoves, grates, etc.	927	791	7,574	8,410	44,281	40,123	384,530	447,309
Sanitary cisterns	228	251	2,235	2,662	6,966	9,565	69,320	89,884
Bedsteads, including tubes therefor	462	487	3,620	4,493	15,087	20,791	133,583	174,992
Hollow-ware	476	430	4,023	4,012	17,700	15,734	146,225	143,002

WILLIAM JACKS & COMPANY,
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13, RUMFORD STREET, LIVERPOOL.
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ZETLAND ROAD, MIDDLESBROUGH.

Notice

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

FOREMAN or Assistant desires change. Technical knowledge and a sound practical experience in engineering, jobbing, and repetition castings. Ordinary and high-duty cast irons.—Box 610, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

A YOUNG Metallurgical Chemist required to control small chemical and physical laboratory and heat-treatment department; also assist in controlling material in iron foundry of an engineering company in the South of England. Reply giving age, details of experience, and salary required.—Box 628, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT Metallurgical Chemist, aged 20 to 25, required for large engineering works in Eastern Counties. Applicant must have good knowledge of metal melting, general foundry practice, and accustomed to metal analytical work. Apply, stating age, salary required, full particulars of experience and previous employment to: Box 634, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman required for one of the largest iron foundries in India. Preference given to candidates having good experience in modern pipe foundries. Salary about £45 per month, but according to qualifications. Free unfurnished quarters, four-year agreement, free passage out and home. Provident fund and home leave on re-engagement. Apply by letter with copies of testimonials, stating age, to: "FOUNDRY MAN," c/o W. ABBOTT, LTD., 32, Eastcheap, London, E.C.3.

FOUNDRY Manager required to take charge of a large iron foundry and small non-ferrous foundry and pattern shop (250 employees) by a company making internal-combustion engines in the South Midlands. The successful candidate must be a first-class practical foundryman with technical experience and a successful record of achievement. State age, full details of experience, and salary expected. Replies will be regarded as confidential.—Reply Box 626, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

LEADING Hand required ironfoundry, used to heavy and medium castings, jobbing work. Excellent prospects for good man not over 45 years of age. Full particulars and wages required to: Box 630, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, for large works in Birmingham district, experienced Cast-iron Foundry Foreman, with knowledge non-ferrous metals. Apply giving full particulars of experience and salary required.—Box 636, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, a Mechanical Estimator for large British firm of Engineers in India. Applicants should have a good general and technical education, be capable draughtsmen and have had a good experience in estimating and rate fixing for machine shop, pattern shop, and iron foundry. Single men not exceeding 30 years of age preferred. Salary about Rs. 600 per month, but according to qualifications. Five years' agreement, with free passages, provident fund and home leave on re-engagement. Apply, by letter, with copies of testimonials, stating age and whether married or single, to: "ESTIMATE," c/o MESSRS. WM. ABBOTT, LTD., 32, Eastcheap, London, E.C.3.

SITUATIONS VACANT AND WANTED—*Contd.*

WANTED.—Practical Metallurgical Chemist for malleable foundry in Walsall, to control melting for rotary furnace and annealing. Reply giving experience, firms served, and salary expected.—Apply: Box 632, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRYMAN, long experience Diesel engine, steam engine, machine tool and general castings. Mechanised experience, moulding machines, sand slingers, cupolas and metals. Estimating and general control. (309)

ASSISTANT Foundry Manager desires position. Practical moulder, sound metallurgical training. Accustomed to mechanised plant, modern cupola practice, sand control. Vitreous enamelling. Control of men. (310)

PATENT

THE Proprietors of Letters Patent Nos. 432,888 and 450,623, relating to Centrifugal Metal Casting Machines, desire to dispose of their patents or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring their full commercial development and practical working in this country. Inquiries to be addressed to: CRUIKSHANK & FAIRWEATHER, 65-66, Chancery Lane, W.C.2.

PROPERTY

MODERN Steelfoundry at Rotherham, main building 65 ft. by 150 ft. (erected 1916); complete with 10-ton crane. Site 1 acre. Siding on L.N.E. Rly. Adjacent canal.—Apply: GORDON, P.O. Box 98, Sheffield.

TENDER

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THE Directors of this Company are prepared to receive Tenders for the supply of the undermentioned Iron and Steel Goods:—

3.—Tyres and Rolled-Steel Wheel Centres.
4.—Steel Axles and Forgings.
5.—Iron Bars and Plates.
6.—Steel Sheets.
7.—Steel Bars and Blooms.
8.—Steel Castings (Wheel Centres).
9.— do. (Miscellaneous).
11.—Chain.
12.—Tubes and Fittings. (Gas, Steam, Electric Conduit, etc.)
13.—Weldless Steel Tubes. (Steam and H.P. Gas, Boiler, etc.)
14.—Iron Castings, Pipes, etc.
15.—Galvanised Sheets.

Specifications and Forms of Tender (upon which alone Tenders will be received) may be obtained on application to the Stores Superintendent at Swindon.

Tenders addressed to the undersigned and marked outside "Tender for Iron and Steel," will be received not later than 10 a.m. on Thursday, November 4, 1937.

The Directors do not bind themselves to accept the lowest or any Tender.

F. R. E. DAVIS,
Secretary.

Paddington Station,
London, W.2.
October 20, 1937.

MACHINERY

WANTED.—84-in. dia. second-hand Drop Bottom Cupola of modern design. State price dismantled f.o.r. and full particulars to: Box 624, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

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Steel Tank, 12 ft. by 12 ft. by 6 ft.
70 b.p. Robey Crude Oil Engine.
Robey Air Compressor, 850 c.f. at 30 lbs.
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One 3-ton Greaves Etchells Electric Furnace, complete with motors, switchgear and transformers.

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Pneu. 12" cyl. Jackman, Plain Jolt Ram; table 5' square; weight 50 cwts.

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